UNIVERSITY of OULU
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SHOCKS THAT SHOOK THE WORLD
HOW EMERGING & DEVELOPED ECONOMIES REACT IN MOMENTS OF CRISIS

A CROSS EXAMINATION OF THE BRICS & G7 NATIONS

Master's Thesis

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ABSTRACT OF THE MASTER'S THESIS

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Abstract

This paper examines 19 major events which include (7) financial crises, (7) terror attacks, and (5) natural disasters over the past three decades and the impact on the financial markets of the BRICS and G7 bloc of nations. The BRICS, emerging nations, comprise of Brazil, Russia, India, China, and South Africa, whilst the G7 developed nations comprise of the US, UK, Canada, France, Germany, Italy, and Japan.

The analysis on how 19 catastrophic events affect the BRICS and G7 economies was conducted using an Event Study Methodology implementing the Market Adjusted Model. The methodology popularized by Fama, examines the Abnormal Returns (ARs), Average Abnormal Returns (AARs), Cumulative Abnormal Return (CARs), and Cumulative Average Abnormal Returns (CAARs) to determine if there are statistical significances using the t-statistical significance tests over an event window of (-5, +5). Returns of the market indices are obtained from Yahoo Finance for Brazil's returns and Thomas Reuters DataStream for the remaining 11 for the period between 1989 to 2018. The indices are benchmarked against the MSCI All Country World Index (ACWI) Index, which captures large and mid-caps across 23 developed and 26 emerging markets, covering approximately 85% of equities markets globally.

We find that emerging economies (BRICS) react stronger to financial crises and terrorist attacks and for a prolonged period in comparison to those of the developed nations (G7). Furthermore, it was found that there was no statistical significance in neither the BRICS nor G7 nations during natural disaster events, apart from The Great Tōhoku (Fukushima) Earthquake and Tsunami in Japan. Moreover, this study shows a contamination effect between nations that share a geographical, and more importantly, trade partnership, but this spill-over effect has reduced over time as market participants have become more acquainted and resilient to these events occurring, especially with terror attacks.

Keywords

Event Study, BRICS, G7, Emerging, Developed, Terror Attacks, Financial Crisis, Natural Disasters

Additional information

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Espoo, Finland December 2020

Joseph Bentley

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LIST OF ABBREVIATIONS

The following table lists the various abbreviations and acronyms used throughout this paper.

ACWI	All Country World Index
AR	Abnormal Returns
AAR	Average Abnormal Returns
BRA	Brazil
BRICS	Nation bloc which includes BRA, RUS, IND, CHI, RSA
CAN	Canada
CAR	Cumulative Abnormal Returns
CAAR	Cumulative Average Abnormal Returns
CHI	China
EMH	Efficient Market Hypothesis
FRA	France
G7	Group of 7, comprising the USA, UK, CAN, GER, FRA, ITA, JAP
GDP	Gross Domestic Product
GER	Germany
GFC	Global Financial Crisis
IMF	International Monetary Fund
IND	India
ITA	Italy
JAP	Japan
RSA	South Africa
RUS	Russia
UK	United Kingdom
USA	United States of America

1 INTRODUCTION

1.1 Background and Significance

Over the past Century financial literature has examined the financial markets, the decisions of the participants, and market operations within various exchanges whilst being subjected to multiple factors in which a multitude of events and/or anomalies have impacted the market. During the past five decades there has been a rich body of literature surrounding negative events that have plagued the globe that include financial crashes, terrorist attacks, and natural disasters.

More recently, at the beginning of the new millennium saw significant events that would forever change the world we live in. With the strides in technology leading to the internet boom in the late nineties, ultimately crashing down to reality in 2000 which would be known as the Dotcom crash of 2000, or a year later, the world hopelessly watched as two American airliners ploughed into the World Trade Centres, forever changing the airline industry, the way we travel, and forcing a brutal realisation that terror could be inflicted on the West, in a large and calculated scale rather than on the battlefields of the East. Furthermore, towards the end of the decade saw the largest financial crisis since the Great Depression occur in 2008 with the Global Financial Crisis bringing the US and the rest of world to the brink of economic and fiscal collapse. All these events have painted a dark and permanent stain on the globe in which we have ultimately had to adjust our lives as a result. Regardless of where or how these events began, what is certain is that they have all resulted in resounding and lasting implications on the global markets and economies surrounding them. As globalisation is almost at its peak, according to some, events that occur in one nation no longer stay within that immediate region but have impeding and unintentional consequences for those across borders, and across continents.

Within this theme, the global powerhouse of the industrial world and economic prosperity of the majority western world has seen innovation and growth throughout the Twentieth Century slow down as a new and emerging group of nations from the East continues to expand with Asia at the forefront of a new era of innovation and

technological and economic superiority, and African nations tackling corruption in a land full of natural resources. By no means does this mean the developed nations will be left behind, with the US as dominant as ever on the world stage and having the largest economy in the world. Although, with China's dominance in the Asian continent cemented and its increasing presence in the African continent, most analysts and policy makers view China as the new "threat" to America's superiority rather than past rivalry with Russia.

As the United States of America and most of Western Europe still recover from the last two major financial crises to occur since the Great Depression, it brings into question the fragility of the financial markets as new players have started to emerge, threatening to shuffle the once powerful and feared nations of the West. As the production machine begins to slow down in the world's richest nations, of which they had experienced unparalleled growth during the industrial revolution, now face the real dilemmas of stagnant growth and pressures to innovate as domestic labour is sent offshore to cheaper and financially attractive markets in the emerging world. And in this emerging world are five key nations in which some economists and commentators believe will change the financial and economic landscape over the next few decades, and they are, the BRICS economies.

In 2003 the emergence of four nations spanning all four corners of the globe began to attract the attention of financial and economic professionals who characterized these nations as having rapidly growing economies and an increasing international influence in their respective regions. The nations of Brazil, Russia, India, and China had all been experiencing tremendous growth in their respective regions. Later that year, this group of nations would become known as the BRIC alliance, coined by the investment firm Goldman Sachs' chief analyst Jim O'Neill in 2001, in his publication "Building Better Global Economic BRICs". (O'Neill 2010)
However, this alliance of nations was just a namesake with no real significance until 2009, when these four countries began to cooperate with each other.

In the Russian city of Yekaterinburg, the four leaders of the BRIC countries gathered for the first summit in which economic and social objectives were discussed. A year

later, in December 2010, South Africa joined the economic alliance and thereafter became known as the BRICS bloc of nations, attending the third summit for the first time together in the city of Sanya, China in April of 2011.

Furthermore, economic analysts expect Brazil, China, India, and Russian to join the US in becoming the five largest economies by 2050. With the collective five nations contributing to 40% of the world's population, and between them have a combined global GDP of more than 20% which gives the BRICS an increasingly important role in the international community and therefore making this study's focus more relevant.

However, there is some scepticism about the growth and significance of the BRICS grouping of nations. These five economies have all experienced some levels of shock to their respective stock markets that have delayed or hindered growth. Be it natural catastrophes, political upheavals, economic sanctions, financial crises, war, or terrorist attacks, all these emerging economies have experienced multiple facets of instability.

The Russian Federation has in recent years faced economic and political sanctions that have resulted in a volatile economy, with their oil and natural gas industry falling drastically recently as prices fall globally due a spat with their Middle Eastern rivals. Coupled with the US sanctions for their role in Crimea's annexation and other political scandals, Russia´s growth has all but come to a dramatic U-turn.

Moreover, Brazil, another member of the BRICS has had multiple political scandals which have almost always involved some form of economic manipulation and seen the country decline drastically as social and political rest continues to ensue.

Another issue to point out and is a key theme within the BRICS nations, is that these nations have experienced generational changes in which society has had to drastically change and adapt to new risks and uncertainties. From the collapse of the Soviet Union, to governmental unrest in South Africa, censorship in China, all of these nations have experienced and overcame events in which most of the developed world has not seen since the Second World War.

Alternatively, there are a group of developed nations that hold annual meetings to promote consensus on issues ranging from economic growth and crisis management, energy, global security, and terrorism. This group are known collectively as the Group of Seven or G7, with Japan, the US, UK, Germany, Italy, and France making up the economic bloc of nations. Formed initially in 1975 with the exclusion of Canada, who later joined in 1976, the group of nations was established to allow a forum between the industrial powers at the time to discuss economic and political concerns.

Later in 1998, at the end of the cold war, Russia joined the Group of Seven, thus becoming the Group of Eight or G8. However, after multiple controversies and concerns about Russia's human rights issues and violations of international laws, Russia was removed from the G8 after annexing the Ukrainian city of Crimea in 2014.

These factors and the impact recent global catastrophes have had on the BRICS economies and their market participants makes this study more relevant than ever with studies such as this adding commentary which can aid a range of financial participants such as portfolio managers, sophisticated investors, and policy makers. The need to be aware of the adverse effects that major negative events have upon a variety of markets may bridge the gap between the emerging and developed markets as more participants enter these emerging markets and help to promote sound global financial stability.

1.2 Previous Literature

1.2.1 Significance of News on the Market

In terms of news, events that are announced to the market can either comprise of good or bad news that will impact the market and participants within them accordingly. The very nature of the market and the efficiency of information, regardless of whether it is of a positive or negative nature, reinforces the importance of continued research into certain phenomena that might affect not only a nation's financial market performance, resilience, and participation in times of crisis or triumph, but the possible contagion

effect to other markets that may be inadvertently be affected due to the increase of globalization and a more interconnected global financial system.

There have been a variety of studies for example that examine the effects that new information has had upon stock markets, with the consensus that negative events have significant negative impacts on the market, whilst the markets react insignificantly to good news. Studies such as Frey and Kucher (2000:2001), Frey and Waldenstorm (2004), Choudhry (2010), and Hudson and Urquhart (2015) observe the effects bad news events have on the markets of the US, Europe, and the UK, given partially to their involvement in the world's major conflicts and having sophisticated capital markets. Given these findings on the worlds most developed markets, it is therefore a valid question to determine if these shocks on the markets flow through to other markets reliant on these developed economies and this has led to a wide body of literature examining the contagion phenomena.

1.2.2 The Contagion Phenomena

Now that we understand the role and significance news has upon the market and that bad news has a detrimental effect on stock markets returns, we should try to gauge the significance of this news on the overall efficiency of the world market, which ultimately means examining how other markets react to global that may not be within their geographical region.

Negative shocks on one country that flow to another are referred to as a contagion or spill over which its effects are important in identifying the financial implications both for implementing policies as well as for investors, who need to understand the nature of changes in stock markets to evaluate the potential benefits of international portfolio diversification and the analytical assessment of risks. (Moser 2003)

The importance of this phenomena is important to consider in this study given that we examine an aggregate group of nations across similar economic traits and examine them within another economic group. In this case, the BRICS AND G7 nations representing the emerging and developed nations, respectively.

Moreover, whether good or bad news has a significant effect on market in which such a phenonium may exist is also an important consideration to examine. Studies by Bae and Karolyi (1994), Beirne, Caporale, Schulze-Ghattas and Spagnolo (2009), and Pereria (2018) all examine the impact of good and bad news announcement on various developed and emerging markets and examine whether there any signs of a contagion. They find that bad news affects both the domestic and foreign nations negatively, along with more significance, thus demonstrating that bad news does indeed cause a contagion effect. Furthermore, they find that good news has either a good or negative reaction on the market, but to a lesser extent.

Given that we now know the significance bad news has upon the markets, there have been studies examining the effects of various catastrophise upon various markets. One area of focus has been on financial crises and how they have affected the markets within their trading blocs as well as outsiders. Examples of financial crises examined within the literature include, but not limited to the Mexican crisis in 1994, the Asian Financial Crisis in 1997 and the Russian crisis in 1998. (Forbes 2002, Forbes & Rigobon 2002)

Moreover, there exists a greater body of research that examines the importance of global market integration between the emerging and developed nations and whether there are significant reactions to a range of catastrophic events that may result in major implications for portfolio diversification and policy makers. They find that an increase in correlation during a crisis relative to a stable period examined attributes to a contagion effect occurring in most cases examined. (King & Wadhwani 1991, Hamao, Masulis & Ng 1990, Baig & Goldfajn 1999, Claessens, Parka & Dornbusch 2000, Samarakoon 2011, Grima and Caruan 2017)

In addition, it has been found that BRIC economies suffer from US led crises, regardless of how volatile each economic bloc was beforehand. Or in other words as integration of the markets have increased over time between the developed and emerging nations, the contagion effect has been present across the different economic nations. (Aggarwal, Inclan, & Leal 1999, Chittedi 2009, Aloiu, Nguyen & Ben Aissa 2011, Buttner & Hayo 2011)

Furthermore, there have been other studies expanding on the grouping of nations that have looked to examine the specific relationship between the BRIC nations and most advanced of the developed markets, these being the US and the UK. As with the other studies mentioned, they find that the BRIC nations are heavily affected by a contagion effect from events occurring in developed nations. Interestingly though, they find this is less so with events occurring in emerging nations affecting developed nations. (Aloiu et al. 2011, Hwang, Min, Kim, & Kim 2013, Bekiros, 2014)

1.2.3 Are the Markets Efficient?

Whether or not there is a contagion present during a catastrophic event, the timing of the information being released upon the market in a timely way in which all information is correctly priced into the market is a major concern for all market participants and has over the years provided quite the debate about its existence. The Efficient Market Hypothesis (EMH) often credited by Samuelson's (1965) suggests that investors are rational and consider all available information in the financial decision-making process.

A market is deemed to be efficient when the financial market in which the arrival of new information is reflected onto the financial asset prices, is immediately recognised through the returns, ensuing that investors are not able to make excess gains from any potential information leak on the market. (Yolsal 2011)

Fama (1970), a pioneer of the EMH and a strong defender of the theory suggests three forms of efficiency that explain how returns are priced and perceived on the market. These being, the weak form, in which a market is deemed efficient if the current price reflects all information contained in the past prices, and therefore it becomes impossible to develop technical analysis to identify mispriced stocks. Fama (1970)

The semi- strong form, which examines the speed of price adjustments on stocks and returns react to information that is readily available and expected by the public, such as annual financial reports. This form implies that as soon as publicly made information is available, it is rapidly integrated into the prices, which impedes

investors from making significant gains by using this information to make forecasts of returns. If this form remains true, it means profit from both technical analyses and fundamental analysis is unobtainable. (Cuthbertson 1996)

And the strong form which examines investors or groups who have access to inside information and determine whether they can earn excess returns off the markets based on this insider knowledge. Fama finds that the market prices do reflect all insider and public information; therefore, even investors with secret knowledge of an event cannot profiteer from leaked information.

However, as with most theories, there has been strong debate about the validity of such an efficiency, in which certain stock price anomalies have brought into question the markets efficiency.

A stock price anomaly can be defined as behaviours or patterns in an asset returns which are consistent, thus resulting in an investor making a significant gain/profit from these patterns in the market as they take advantage of the predictability of those returns. This has contributed to much debate and continues to being challenged to this day as the literature goes back and forth in addressing these anomalies. (Schwart 2003, Yolsal 2011)

Studies attributing such anomalies include factors regarding transaction volumes, volatility, calendar, and seasonal anomalies, all of which have been observed in financial market and as such, raised the importance of how these anomalies have affected the decision-making process and whether they have altered the marketplaces and their “efficiency”. (Treynor 1965, Jensen 1968)

1.2.4 Event Studies

We know have an idea of how bad news can impact a market, the potential contagion effect, and the presence of an efficient market. However, to continue to example these events and anomalies, either in the future or the past events, we must have a framework to test them.

The event study is one such research methodology and provides the researcher a simplistic and flexible method to test these questions and more.

The event study has been attributed to the early work of Dolley (1933) in which they examine the stock price reaction to stock splits in a selected sample of 95 splits over a period between 1921 to 1931. The study finds that the price of the 95 splits increased in 57 of the samples selected and the remaining 26 sample splits, the price declined.

Moreover, the way in which we conduct an event study today and the literature surrounding it has been attributed to two pioneering studies by Ball and Brown (1968), and Fama, Fischer, Jensen, and Roll (1969). They both examine how certain stock splits and events impact the market and as time went by, this method became an unintentional research methodology that has grown into popularity among fellow researchers. As a consequence of this popularity, the body of literature surrounding event studies has extended significantly with sub-sections of literature looking at the violations of the statistical assumptions implemented in an event study along with making according adjustments in the design of an event study to cater for specific hypotheses. (Corrado 2011)

Furthermore, research by Brown and Warner (1980, 1985) recognise the importance of modifications to such studies and discuss the implementation issues with data sampled at monthly intervals, whilst their later paper discusses data sampled at daily intervals to overcome those issues. (MacKinlay 1997)

This latter study of MacKinlay's has become the most prevalent use of an event study and allows the researcher the opportunity to measure the abnormal returns more precisely than had been possible with monthly data.

Moreover, the use of the event study and the improvements to it has further made the methodology appropriate in examining a variety of negative events such as financial crises, terror attacks, and natural disasters.

1.2.5 Financial Crises

During the past few decades there have been a variety of financial disasters that have had detrimental effects on the international financial markets such as the Mexican Debt Crisis of 1982, the Asian Financial Crisis of 1997/1998, the Global Financial Crisis of 2007, and the Eurozone Sovereign Debt Crisis shortly thereafter. The number of events and the frequency at which they occurred have put a spotlight onto the financial industry with investors becoming more critical of the events that occur during a crisis and the effects it has on their investment returns.

Studies conducted on the Mexican crisis highlighted the occurrence of a contagion effect in Latin America which caused a catastrophic effect on the financial markets in the America's but also Europe. Studies by Schoder and Vankudre (1986), Cornell and Shapiro (1986), Brown and Warner (1985), Smirlock and Kaufold (1987) examine the effect that the crisis has on various markets and found that markets react negatively to a bad news event. Their findings suggest there is a unified reaction to negative announcements on the market, with markets reacting negatively to the crisis occurring in this emerging part of the world from those nations that are in the developed, but to a lessor degree.

1.2.6 Terror Attacks

Terrorism has been a growing problem over the past four decades, with the frequency and impact increasing dramatically over the last two decades. Much of the literature surrounding terrorism and the effects on the markets focus on three major attacks which occurred in the last two decades, The attacks on New York City on September 11th, 2001, the Madrid bombings of 2004, and the London bombings in 2005. Studies by Carter and Simkins (2004), Chen and Siems (2004), Nikkinen and Vahamaa (2010), Kollias, Papadamou and Stagiannis (2011) examine the effects that these attacks had on various stock markets and found they had significant negative impacts on markets. Whilst the US market has become more resilient than earlier attacks in history with the US's recovery to a terror attack quicker than other international markets.

Further studies by Brounen and Derwell (2010) examine the effects of terrorist attacks on various stock markets in major economies of the world. They find that terrorist attacks have only mild negative price effects, rebounding after a week of the event occurring. Nations that suffer the terror attacks domestically, experience the most reaction on their stock markets, with the contagion effect having less impact on nations outside the attack.

Arin, Cifferi and Spagnolo (2008) also find significant negative effects on the market, especially in the Asian and Middle Eastern regions. They show these areas had more adverse effects than the two European countries examined, the United Kingdom and Spain. Their finding signifies that emerging markets experience more significant shocks to their markets for longer, whilst developed nations are more resilient in times of terrorist attacks, thus reinforcing the importance of this study.

1.2.7 Natural Disaster

Lastly, there has been an increasing number of studies examining the impacts of natural disasters on various markets, although this has mainly looked at specific sectors such as insurance, construction, and real estate on the domestic level. The common findings are that natural disasters have a negative effect on market returns and markets react to the bad information almost immediately. However the significance and impact of these events are small compared with financial crises and terror attacks. (Shelor et al. 1992, Yamori & Kobayashi 2002, Odell & Weidenmier 2004, Worthington & Valadkhani 2004, Yang et al. 2008, Li 2013, Tao 2014)

1.3 Purpose and Motivation

The purpose of this paper after examining the prior literature is to therefore examine how major global calamities have affected, if at all, the world's key emerging economies and developed nations by examining the impacts of key negative events and the reaction of their respective stock indices.

Over the past few decades, there have been a variety of global financial crises, terror attacks, and natural disasters that have impacted nations across the globe and as such created a large amount of interest, in terms of policy making and investment behaviour. Given the increase of catastrophic events occurring, there has been a growing amount of literature examining these events and this paper will hope to contribute to this body of literature.

The significance of negative events that have plagued countless generations and brought markets to the brink of collapse for centuries has also increased uncertainty in a challenging time that can test the foundational structures of institutions that have stood unchallenged for so long.

With the political and economic landscape looking more rocky than stable, it will be interesting to see how major global markets react to major shocks throughout the globe and whether the market reaction and therefore investor behaviour has changed over time. With the increase in social media and online media in general, the general population are becoming more vocal and aware of their position on the global stage and it will be interesting to see how, if at all, the impact negative events have on the markets which ultimately is based on investor behaviour and the efficiency or inefficiencies of the markets they operate in.

Furthermore, this study aims to add to the surrounding literature on the impact bad news has on the markets in terms of a short term reaction and determine if there is any contagion effects and/or similarities between the major developed and emerging economies shortly after a event occurring.

Past literature has largely focused on a small sample of nations with a close geographical or trade partnership/bloc, domestic reaction to an event, or on other economic factors such as GDP. This paper hopes to add to this literature in terms of examining the BRICS and G7, two key economic groups of nations that are leaders in the emerging and developed markets.

Additionally, given the extensive literature on financial crises, terror attacks, and natural disasters, this paper will contribute to this existing body of literature on whether the 12 selected economies and their corresponding markets have become more resilient overtime, and hence would provide a view on the efficient market hypothesis of Fama.

It will be interesting to see if the BRICS economies show the same reactions against the markets of Western European and Northern America and whether they experience the same volatility spill overs as Europe and America have experienced. As the BRICS economies continue to grow, especially China and Russia, more research regarding their capital markets and reaction will be needed for financial and government policy makers to better understand the impact certain events, both good and bad, have on the international financial markets in the future.

To the author's knowledge, there has been no prior research or study examining the BRICS and G7 nations as a collective in examining the reaction of the markets in a range of financial crises, terror attacks, and natural disaster events. As such, this study aims to shed light on whether major global events affect both emerging and developed economies, and if there are any similarities between the economic blocs and if the markets react quickly to the information.

Lastly, for disclosure and in line with the Oulu Business School thesis guidelines, this study was inspired by my previous studies conducted during my undergraduate studies in Australia. During my honours year, in which I wrote a bachelor's thesis, entitled "*Do Eurozone Sovereign Credit Downgrade Events Effect the Banking Sector: An Australian Study*" I examined the impact that the Eurozone Debt Crisis had upon the Australia Banking Sector. As such, there are some parts, in relation to the event study literature and financial crisis literature, that I have used in this study. Although I have made drastic changes in terms of significant updates, providing a more detailed commentary, and eliminating irrelevant literature
based on the previous papers scope. (Bentley 2013)

1.4 Structure of Thesis

The structure of this thesis begins with a discussion of the prior literature on various key topics and themes within this papers scope and has been divided into three chapters.

Chapter Two will discuss the origins of the Efficient Market Hypothesis, the three forms of efficiency, and the arguments against such a theory. Chapter Three investigates the contagion phenomenon and how nations that are integrated might be subject to such an effect. Whilst Chapter Four discusses how Event Studies have been used to examine a variety of catastrophic events and the implications on various markets.

Continuing from the literature, Chapter Five provides a detailed account of the Event Study Methodology with discussions on the framework, its implementation, and considerations in conducting a successful event study with concluding remarks on the data used in this study.

Chapter Six covers the analysis and commentary of the empirical results of the study, and this chapter is divided into three sub-sections as per event categories of financial crises, terror attacks, and natural disasters.

Lastly, Chapter Six ends with a discussion of the key findings in the paper, our contribution to the wider literature, limitations of the study, and the future directions that could be made to further enhance the research in this field by others with the references and appendices included thereafter.

2 STOCK MARKET EFFICIENCY

2.1 Background in Market Efficiency

One of the most renowned theories of our century, the Efficient Market Hypothesis (EMH) is often credited by Samuelson's (1965) study entitled "Proof that Properly Anticipated Prices Fluctuate Randomly". However, Campbell, Lo, and MacKinlay (1997) attribute the theoretical contribution of the Efficient Market Hypothesis to earlier works by Bachelier (1900) and the empirical contribution to Cowles (1933) with Samuelson (1965) and Fama's (1965) studies providing the fundamentals for how the theories are used today.

The theory suggests that investors are rational and consider all available information in the financial decision-making process. Furthermore, a market is deemed to be efficient when the financial market where the arrival of new information is reflected onto the financial asset prices is immediately seen through the returns, ensuing that investors are not able to make excess gains from any potential information leak on the market. (Yolsal 2011)
As such, both technical analysis and fundamental analysis, which examine past stock prices in attempt to predict future value and analysing corporate information such as earning and asset values to aid investor select undervalued stocks, respectively, would not be possible in obtaining returns greater than using a randomly selected portfolio of stocks. (Malkiel 2003)

EMH has been tested using forms of event studies using residual analysis techniques first introduced by Fama, Fischer, Jensen, & Roll (1969), in which studies have demonstrated on average that the market does indeed react quickly to the arrival of new information confirming the validity of the market efficiency hypothesis. Although there is a range of contrarian literature which opposes these findings in the form of anomalies, which I will discuss later in the section.

Regarding the overall aspect of "new information" being released efficiently on market, we must first understand what new information is. New information occurs when an event or announcement that may influence stock prices at the present point in

time becomes random in the future. In contrast, old information according to Fama (1965), is characterized into three types of old information, which correspond in three different categories within the Efficient Market Hypothesis. These being weak-form efficiencies, semi-strong efficiencies, and strong-form efficiencies. (Fama 1970)

Moreover, three decades since Fama's pioneering studies within market efficiency and event studies, these categories where again revisited in 1991 as Fama examined the contributions of others to this area of study such as Lo and Campbell (1988), and French and Roll, (1986), and ultimately updated these categories of efficiency into Return Predictability, Event Studies, and Tests for Private Information. (Fama 1991)

2.2 Weak Form/Return Predictability

In his earlier work, Fama (1970) describes a weak form efficiency, where the information subclass the researcher is interested in is either historical returns or prices. If the market efficiency is considered weak, investors will be unable to make excess gains on past prices or returns. The consensus of studies surrounding this form of efficiency find that weak form efficiencies support the efficient market hypothesis, which opens the door for studies looking at semi-strong tests to determine if these results (match). Furthermore, if these results are indeed a weak form of the EMH, a market is deemed efficient if the current price reflects all information contained in the past prices, and therefore it becomes impossible to develop technical analysis to identify mispriced stocks.

In his 1991 paper, Fama decided to reclassify the form given the limited scope at the time of only including the forecasting power of past returns. Reclassifying into return predictability covers a broader area of tests for return predictability, which includes forecast returns and their variables such as dividend yields and interest rates. Moreover, given the literature of anomalies such as size effect, seasonal (January) returns, and security price volatility, this first stage covers the cross-sectional predictability of returns that tests these anomalies.

2.3 Semi-Strong Form/Event Studies

The second classification of market efficiency is the semi-strong tests that examines the speed of price adjustments on stocks and returns react to information that is readily available and expected by the public, such as annual financial reports. This form implies that as soon as publicly made information is available, it is rapidly integrated into the prices, which impedes investors from making significant gains by using this information to make forecasts of returns. If this form remains true, it means profit from both technical analyses and fundamental analysis is unobtainable. For example, asset prices that already reflect all publicly available information cannot make abnormal returns form either analysis. (Cuthbertson 1996).

Fama's 1991 changes for this form was only to the title, rather than the coverage and as such is now known as, event studies, which we deem appropriate given the popularization of Fama's unintentional methodology at the time of forming the semi-strong form, which is commonly used to test the market efficiency in the adjustment of prices to public announcements today.

2.4 Strong Form/Insider Trading

The third form of market efficiency, preciously known as the strong form, examines investors or groups who have access to inside information, and whether they can earn excess returns off the markets based on this insider knowledge. Fama finds that the market prices do reflect all insider and public information; therefore, even investors with secret knowledge of an event cannot profiteer from leaked information.
In other words, the strong form reflects the semi form, with prices reflecting all information, both public and private, which therefore prohibits profits being made from either technical analysis, fundamental analysis, nor insider trading.

Given that this form tests private information, Fama's 1991 paper decided to rename the form in a more descriptive aspect, and now the strong form is known today as "tests for private information". (Fama 1991)

2.5 Opposition to the Efficient Market Hypothesis, the Case of Anomalies

As previously mentioned, in contrast to Fama and other studies that signify the market is indeed efficient and thus stock prices reflect new information, there has been an increasing amount contrasting literature that scrutinizes this theory and suggests to some extent, the ability to predict returns based on behaviour of past stock prices, with relevance to notable market anomalies and investor behaviour.

A stock price anomaly can be defined as behaviours or patterns in an asset returns which are consistent, thus resulting in an investor making a significant gain/profit from these patterns in the market and taking advantage of the predictability of those returns. This nonetheless has led to much debate and is still being challenged to this day as the literature goes back and forth in addressing these anomalies (Yolsal 2011, Schwart 2003)

The so-called rise of such a debate was particularly prevalent within the behavioural finance field in the mid-1980s, around twenty years after Fama's paper entitled "*Efficient Market Hypothesis*". Contrasting with Markowitz's Efficient Market Hypothesis, it is said that in fact investors do not act rationally and as a result financial models do not fit the market. There have been hundreds of studies attributing factors such as transaction volumes, volatility, calendar, and seasonal anomalies which can be observed in financial market and which has bought the importance of how human behaviour has been affected by these anomalies and how the decisions making process may be altered in the marketplaces depending on an investor's individual nature. Additional, in relation to the third form, we know of instances of insider trading occurring, which therefore brings into question the strong form market efficiency. (Treynor 1965, Jensen 1968)

More recently, a paper by Malkiel (2003), who wrote "*A Radom Walk Down Wall Street*" published in 1973, investigates these anomalies in the literature and provides a sound analysis on the age-old question of whether the market is indeed efficient or inefficient. One of those anomalies is the equity risk premium puzzle which continues to baffle researchers and economists. This puzzle questions the efficiency of the

market as it suggests that markets are less than fully rational in the existence of a very large historical equity risk premium that seems inconsistent with the actual riskiness of common stocks that can be measured statistically. For example, studies have been unable to fully comprehend why it has been found that equities over time have produced significantly highly returns than those of bonds.

But as with most anomalies, there have been attempts to explain this, with Fama and French (2002), attributing this phenomenon (equity risk puzzle) to large, unexpected capital gains, rather than a random anomaly. (Malkiel 2003)

As with most literature that debates market efficiency and the presence of market anomalies, there are no black and white solutions. Malkiel goes on to emphasise that there will be those market participants who will be less rational and therefore give the ability of others to make predictions on those irregularities, thus deeming the market inefficient. However, as time goes on, these irrationalities will be priced into the market and no longer persist, which will end the investors ability of obtaining extraordinary returns from this, or in other words making the market efficient. In conclusion to his analysis, he quite adeptly concluded with:

> *"*If any $100 bills are lying around the stock exchanges of the world, they will not be there for long*"* (Malkiel 2003, pg. 82)

3 MARKET CONTAGION, CROSS-MARKET LINKAGES, AND INTEGRATION

3.1 Contagion Phenomenon in the Presence of Market Integration

The contagion phenomenon and its effects are important in identifying the financial implications both for implementing policies and for investors, who need to understand the nature of changes in stock markets to evaluate the potential benefits of international portfolio diversification and the analytical assessment of risks. (Moser 2003)

In both a theoretical and empirical sense there is no consensus about whether events that cause cross-county transmission should be considered a contagion. There has been various definitions of a contagion with Forbes and Rigobon (2002) describing a contagion as a significant increase of co-movements of a particular market after an initial shock. Furthermore, Bonga Bonga (2018) delves into two variations of contagion, with the latter being relevant for this study, being an investor-behavior contagion. This type of contagion Bonga explains, is the result of a change in investor behaviour which alters the investment flow which cannot be explained by economic fundamentals. (Bonga Bonga 2018)

For example, say that in one emerging country there happens to be a financial crisis which results in investors withdrawing funds from many or all other emerging markets without examining the fundamental differences in economic status. If this irrational behaviour occurs, then nations that have sound economic fundamentals will be seriously affected regardless, which is the definition of a contagion.

The importance of this phenomena is important to consider in this study given that we examine an aggregate group of nations across similar economic traits, with the BRICS representing the emerging nations, and the G7, the developed.

Given the implications of such a phenomenon occurring it is no surprise that there is a large body of literature examining the contagion of an event occurring, with prevalence in financial crises research. With several studies having analysed these contagion

effects in various financial markets, for example in Mexican crisis in 1994, the Asian Financial Crisis in 1997 and the Russian crisis in 1998. (Forbes 2002, Forbes & Rigobon 2002)

Earlier studies by King and Wadhwani (1990), and Lee and Kim (1993) show there to be an increase in correlation during a crisis relative to a stable period examined which they attribute to a contagion effect occurring.

King and Wadhwani (1991) examined the US crash of 1987 and find a contagion between New York, London, and Tokyo immediate after the market crashing. Whilst Hamao, Masulis and Ng (1990), examine the same cities, look at both good and bad news on the market and corresponding volatility and find that the spill over effects is more prevalent during times of a financial crisis. These finding will be interesting to consider during the Dotcom in 2000 and Chinese Black Monday of 2015.

Baig and Goldfajn (1999) examine the Asian Financial crisis and use a cross-market correlation for exchange rates, stock returns, interest rates, and sovereign bond spreads. They find that there is evidence of contagion and high correlation among, stock returns which that spreads directly and therefore the presence of risk perception of financial markets, indicates that pure contagion may be the result of the behaviour of investors or other financial agents. Whilst Claessens, Parka and Dornbusch (2000) examine the same financial crisis and find that market movements are either reinforced or weakened in periods of high turbulence. Interestingly, they also find that negative shocks have a more profound impact on other markets, which also respond negatively, which contrasts with good news which can lead to either a positive or negative market responses. They attribute this finding to the behaviour of investors on the markets that tend to exit all markets during a crisis period.

A later study by Samarakoon (2011) examines the impact on emerging markets and the US to shocks and find that interdependence is seen in relation to US shocks in contrast with emerging market shocks that present a contagion effect. Furthermore, Grima and Caruan (2017) find that BRIC economies suffer from US led crises, regardless of how volatile each economic bloc was beforehand.

3.2 Cross Market Linkages & Integration in Emerging and Developed Nations

Regarding integration of the financial markets, which is when markets are incorporated with one another and considered an important aspect to market participants, Buttner and Hayo (2011) find although this benefits the access to foreign capital, the downside is the vulnerability during a financial crisis that occurs within one of those nations.

An earlier study by Aggarwal, Inclan, and Leal (1999) examine events that caused significant impact on emerging nations markets volatility and find volatility comoves between them during such events as a financial crisis. Whilst Aloiu, Nguyen and Ben Aissa (2011) examine cross market linkages between the US and BRIC markets during financial crises. They show that the nations within the BRIC have greater dependency on the US in nations that rely heavily on commodities such as Russian and Brazil, whereas China and India do not.

Chittedi (2009) examinate this relationship between the BRIC nations and US, UK, and Japanese markets and found that the US, along with Japan, influence Indian stock market due to international trade, which contradicts Aloiu et al. (2011) findings. Moreover, and important for context of this study, they also found that the BRICs and developed economies of the US, UK, and Japan were more integrated than the past.

Furthermore, Hwang, Min, Kim, and Kim (2013) looked at the daily returns of 10 emerging nations in comparison to the US for a four-year period between 2006 and 2010. They found spill-over across the 10 emerging nations examined in which they classified the spill-overs into contagion, herd behaviour, and post crisis adjustment.

The integration of the markets increasing over time between the developed and emerging nations of the BRICs was also found to be true in Bekiros (2014) paper that included the Global Financial Crisis and the Eurozone Sovereign Debt Crisis with a contagion present across the different economic nations.

3.3 Contagion Effects on Good or Bad News

Given that we recognize a contagion effect exists along with the presence of integration that can emphasise such a contagion, the effect that good or bad news has upon such a phenonium is important to examine.

Bae and Karolyi (1994) study the Japanese and US markets between 1988 and 1992 and find that news within a examined market does influence short-term volatility of stock prices to the other market. Moreover, they also find that bad news from both the domestic and foreign nations has a more significant impact on the volatility of returns than good news does.

Over a decade later, Beirne, Caporale, Schulze-Ghattas and Spagnolo (2009) paper examined the spill over between developed economies and emerging economies. They find that volatility in emerging stock markets is higher in periods where mature markets are in crisis. Whilst Pereria (2018) analyses and extends the study of contagion for the BRICS emerging stock markets in the context of the last two international financial crises, the Global Financial Crisis as Lehman Brothers announces bankruptcy, and the European Sovereign Debt Crisis. They use daily data of the national stock indices of the BRICS, EU, and US and find that changes in the EU and US indices does flow onto the returns of the BRICS markets in the short- run.

These findings reinforce the importance of our study and the research question being examined as we examine global market integration between the emerging and the developed nations of the G7 and the BRICS and whether there are significant reactions to a range of catastrophic events that may result in major implications for portfolio diversification, policy makers, and market participants alike.

4 EVENT STUDY: TESTS OF THE SECOND LEVEL OF STOCK EFFICIENCY

The literature surrounding event studies is rich and informative. According to MacKinley (1997), event studies can be attributed to the early work of Dolley (1933). In this pioneering study, Dolly examined the stock price reaction to stock splits in a selected sample of 95 splits over a period between 1921 to 1931. The study found that the price of the 95 splits increased in 57 of the samples selected and the remaining 26 sample splits, the price declined. Interestingly, despite those results and the methods that were used to conduct the study, it would not be until three decades later that this type of study was conducted in a way which would lead to what we refer today as an event study methodology.

This research methodology that is commonly used today, examines a variety of events and their effect on the capital market. Within the body of literature there are two pioneer studies that are often attributed to the use of the event study today and these studies are by Ball and Brown (1968), and Fama, Fischer, Jensen and Roll (1969), with Fama baffled at his research theses unintentional use as a widely accepted methodology. Both papers have been creditied for their use of the market model, along with the development of the Capital Asset Pricing Model (CAPM) by Sharpe in 1964. (Corrado 2011)

Ball and Brown's 1968 study criticized current analytical methods at the time, stating that the:

> "shortcoming of this method is that it ignores a significant source of knowledge of the world, namely, the extent to which the predictions of the model conform to observed behaviour." (Ball & Brown 1968, pg. 159)

As the decades since those pioneering studies of Ball and Brown (1968) and Fama et al. (1969) have gone by, the body of literature surrounding event studies have extended significantly with sub-sections of literature looking at the violations of the statistical

assumptions implemented in an event study along with making according adjustments in the design of an event study to cater for specific hypotheses. (Corrado 2011)

Furthermore, Brown and Warner (1980, 1985) recognise the importance of modifications in which their 1980 paper discusses the implementation issues with data sampled at monthly intervals, whilst their later paper discusses data sampled at daily intervals. (MacKinlay 1997) The latter study, which examined daily intervals, has become the most prevalent use in an event study as it allows the researcher the opportunity to measure the abnormal returns more precisely than previously possible with monthly data.

Using daily data has meant that the effect news announcements have upon the stock market can be examined and had led to a variety of topics being researched such as firm related, policy related, nation related, and so on. Moreover, Fama (1991) has continued to contribute enormously to the area of event studies and highlighted the importance of understanding of how expected returns operate in the economy as well as how expected returns vary over time. The use of an event study has allowed other researchers to add to the field with this methodology being one of the most effective methods, yet simplistic in measuring the effects of news reports upon the financial market.

And finally, with the increase of high frequency and other algorithmic trading, this has resulted in the increased speed of stock prices reflected new information. Additionally, as we are no seeing news events being released through social media tweets at the click of a button, which has also contributed to the increase of intraday event studies which can examine the effect of an announcement to the minute, if the research deems is appropriate. A wide range of researcher find this more appropriate especially in areas such as securities litigation, the investigation of insider trading, or reactions to market price, volume, and spreads. (Marshall et al. 2017)

4.1 Significance of Bad News on Global Markets

Given the breadth of event studies and how they have evolved over the decades in effectively examining an almost unlimited range of scenarios within finance discourse and the wider academic community, the very nature of a news announcement, be it positive or negative, also has a significant impact and corresponding consequence in the implications found in an event study.

Since the stock markets inception, events which comprise both good and bad news impact the market and participants within them. The very nature of the market and the efficiency of information, regardless of whether it is of a positive or negative nature, reinforces the importance of continued research into certain phenomena that might affect not only a nation's financial market performance, resilience, and participation in times of crisis or triumph, but the possible contagion effect to other markets that may be inadvertently be affected due to the increase of globalization and a more interconnected global financial system.

Mackinlay (1997) and Antweiller and Frank (2006) use an event study methodology to determine the relationship that the British media broadcasters, The BBC, news reports have on stock price volatility within the UK Finance Index of the FTSE 100. The study is extremely effective in establishing a relationship between a news announcement and comparing it with a particular market index to determine whether an announcement has a positive or negative effect on the financial market, and on a specific period. They find that negative news has significance on the market in terms of negative reactions whereas good news can either be a positive or negative reaction.

Furthermore, studies that examine the effects war has had upon stock markets have been done to some extent with a consensus view that negative events have significant negative impact on the market, whilst the markets react insignificantly to good news. (Frey and Kucher 2000, Frey and Kucher 2001), Frey and Waldenstorm 2004, Choudhry 2010, Hudson and Urquhart 2015)

These studies observe the effects bad news events have on the markets of the US, Europe, and the UK, given partially to their involvement in the world's major conflicts and having sophisticated capital markets. This type of event typically has a long duration and effects the nations that are directly affected.

There have also been papers that examine the difference of good and bad news announcements and the effects upon the market, with a key paper by Aktar, Faff, Oliver and Subrahmanyam (2011). They find significance in bad news on the Australian All Ordinaries Index, in addition to this type of news having a substantially negative impact on the announcement day, in contrast with good news, which was found to have no significance on the Australian market. This finding in particular, along with the popular body of literature that examines market participants and their reactions to negative events, makes this study relevant in examining instances of significant bad news events or catastrophises and conducting analysis to compare with the surrounding literature to determine if these key negative events in our history has also had an effect on multiple market participants within a similar economic status such as the emerging economies that are known as the BRICS, or within the developed nations of the G7. As such we aim to look at the most significant events considered to be of a highly negative nature and cause of concern for behavioural finance and investor sentiment in extreme occurrences, which are natural disasters, financial crises, and terrorism attacks.

4.2 Event Study Categories

4.2.1 Financial Crises

As mentioned previously, the effect news announcements have upon the stock market, particularly negative events, has been researched extensively over the decades with Fama (1991) contributing enormously to this area and discovering that there was a yearning to gain an understanding of how expected returns operate in the economy as well as how expected returns vary over time. Moreover, the literature on financial meltdowns is rich and there are exemplary studies discussing market and investor reactions to these negative events occurring in the past few decades.

During those past decades there have been a variety of financial disasters that have had detrimental effects on the international financial markets such as the Mexican Debt Crisis of 1982, the Asian Financial Crisis of 1997/1998, the Global Financial Crisis of 2007, and the Eurozone Sovereign Debt Crisis shortly thereafter. The number of events and the frequency at which they occurred have put a spotlight onto the financial industry with investors becoming more critical of the events that occur during a crisis and the effects it has on their investment returns.

Studies conducted on the Mexican crisis highlighted the occurrence of a contagion effect in Latin America which caused a catastrophic effect on the financial markets in the America's but also within Europe. They examine the effect this bad news has on the market and found that the market reacts negatively to such news occurring. Their findings suggest there is a unified reaction to negative announcements on the market, with markets reacting negatively to the crisis occurring in this emerging part of the world. (Schoder and Vankudre 1986, Cornell and Shapiro 1986, Brown and Warner 1985, Smirlock and Kaufold 1987)

Furthermore, the literature concerning developed nations also attests to this very theory during financial crises. During the Asian Crisis of the 1990's, the Global Financial crisis in 2008, and the Eurozone crisis a year later; significant bad news events such as bailouts, austerity measures, sovereign downgrading events, and political upheavals all had negative reactions on the market as investors began to take notice of the growing risks of globalization and the preceding contagion effect that spread quickly and mercilessly. (Kaminsky & Schmukler 1999, Radelet & Sachs 2000, Singala & Kumar 2012)

Moreover, studies have been conducted on a variation of emerging and developed nations such as examining the volatility spill-over effects of a financial crisis and the impact on European, American, and BRICS nations. Bekiros (2014) paper examined the contagion effects of the Global Financial Crisis and the Eurozone Sovereign Debt Crisis and found that the BRICS nations are more internationally integrated after the occurrence of the Global Financial Crisis and reacted significantly to those disasters.

Further studies examine the impacts of the U.S. originating Global Financial Crisis on a variety of emerging markets to examine whether US financial disasters have influence on the market returns of other nations.

Dooley and Hutchinson (2009) used an event study to examine 15 news announcements during the Global Financial Crisis in the US on 14 emerging markets. They found that emerging markets where rather resilient to U.S financial developments during the beginning of 2007 to mid-2008. However, as Lehman collapsed, causing a chain of other significant economic calamities, the emerging markets began to mirror these negative market reactions on their markets.

And finally, a more recent paper by Ranjeeni and Sharma (2015) examined the event of Lehman Brothers collapse on the Shanghai Stock Exchange and various sectors in which they found that the bankruptcy announcement significantly impacted several sectors on the Chinese market which led to their markets to drop significantly.

Given these findings, this study aims to compare those results on the leading developed nations and leading emerging markets on multiple financial crises over time to determine whether there is any significance in how markets react to an event, and the potential contagion they have on other markets.

4.2.2 Terror Attacks

Terrorism has been a growing problem over the past four decades, with the frequency and impact increasing dramatically over the last two decades. Terrorism, as defined by the Global Terrorism Database[1] is:

[1] The Global Terrorism Database (GTD)™ is the most comprehensive unclassified database of terrorist attacks in the world. The National Consortium for the Study of Terrorism and Responses to Terrorism (START) makes the GTD available via this site in an effort to improve understanding of terrorist violence, so that it can be more readily studied and defeated. the GTD is an open-source database, which provides information on domestic and international terrorist attacks around the world since 1970, and now includes more than 200,000 events. For each event, a wide range of information is available, including the date and location of the incident, the weapons used, nature of the target, the number of casualties, and – when identifiable – the group or individual responsible. Source: https://www.start.umd.edu/gtd/

> "the threatened or actual use of illegal force and violence by a non-state actor to achieve a political, economic, religious, or social goal through fear, coercion, or intimidation." (National Consortium for the Study of Terrorism and Responses to Terrorism, 2020)

Since 1970, there has been over 200,000 terror related events occurring, which over the past decade, as shown in Figure 1, has seen a dramatic decrease in occurrence.

Figure 1 - Number of Terror Attacks since 1970 (GTD, 2020)

Arguably the most infamous attacks in recent times which started one of the longest occupations by US forces, was September 11. An attack in which two commercial airliners ploughed into the World Trade Centers live on TV and broadcast across the globe in an event unprecedented in terms of a highly coordinated attack on a Western target. Since that fateful September morning, and the decade that followed, there have been countless terrorist attacks aimed at the international community and transformed, literally, how we live today. From the streets of London and Paris, to the hotel and bars of Mumbai and Bali, terror has been inflicted on a large and dramatic scale and in term spooked markets and investors across the globe at this rise of uncertainty.

These unprecedented events ultimately led to a rise in body of literature surrounding terrorism and the implications on the capital market. The increase in literature on terror event has been attributed to the amount of exposure such terror attacks have upon society today and the scale and locations of such attacks, thanks in part, to the media

and the internet, bringing war into our daily lives, which we in the West have not been accustom to.

Much of the literature surrounding terrorism and the effects on the markets focus on three major attacks which occurred in the last two decades. The attacks on New York City on September 11th, 2001, the Madrid bombings of 2004, and the London bombings in 2005. Studies by Carter and Simkins (2004), Chen and Siems (2004), Nikkinen and Vahamaa (2010), and Kollias, Papadamou and Stagiannis (2011) examine the effects that these attacks had on various stock markets and found they had significant negative impacts on markets.

Chen and Siems (2004) examined attacks dating back to 1915 using an event study methodology and found significant effects on the US capital markets. They however showed that the US markets have become more resilient than earlier attacks in history and the markets in the US show recovery sooner than terror attacks on other international markets.

Arin, Cifferi and Spagnolo (2008) also find significant negative effects on the market, especially in the Asian and Middle Eastern regions. They showed these areas had more adverse effects than the two European countries examined, the United Kingdom and Spain. This finding signifies that emerging markets experience more significant shocks to their markets and for longer, whilst developed nations are more resilient in times of terrorist attacks, thus reinforcing the importance of this study in relation to looking at whether emerging markets are more susceptible to shocks than those of the developed nations.

Nikkinen and Vahamaa (2010) examined the London index, FTSE100 at the time of the New York, London, and Madrid attacks. The authors found that these terrorist attacks had strong negative effects on the FTSE100 with an increase in volatility in all three events. Brounen and Derwell (2010) examine the effects of terrorist attacks on various stock markets in major economies of the world. They find that terrorist attacks have only mild negative price effects, rebounding after a week of the event occurring. Nations that suffer the terror attacks domestically, experience the most reaction on

their stock markets, with the contagion effect having less impact on nations outside the attack. Their finding slightly contrasts with other studies, which show significant adverse effects.

Kollias et al. (2011) find similar occurrences as Brounen and Derwell did in a study the following year. Both studies implement an event study and GARCH methodology and found significant negative abnormal returns when analysing the London and Madrid bombings on the Spanish capital markets. The reactions of the attacks on the London market showed mild reactions, as with Chen and Siems (2004), and Arin et al. (2008) earlier studies. In addition, Kollias et al. (2011) find that the market rebound was much quicker in London compared to the Spanish markets and that the bombings had only a temporary impact on returns and volatility.

Chesney, Reshetar and Kuraman (2011) considers the effects of terrorism attacks on 25 countries over an 11-year period. Using three methodologies, an event study, GARCH methodology, and non-parametric testing, they find that the European and American countries tested do in fact show significant negative reactions to a terrorist attack. Comparing the three methodologies they determine that the non-parametric testing provides the most robust results, especially when measuring market integration and spill over effects, yet can be rather complex to undertake.

Further studies have continued to study the impacts of terrorism and the effects on the markets outside of Europe and North America. Ramiah, Cam, Calabro, Maher, and Ghafori (2010) examined the Australian market and showed significant negative effects during September 11 and mild negative effects during the Madrid and London bombings. Surprisingly, they also discovered that the Australian markets did not react to the terrorist attacks in Mumbai, India or during the Bali bombings in Indonesia. As Australia's neighbouring country, and with many Australian casualties, the markets reacted positively to this bad news. This study highlights that terrorist attacks do not necessarily signify negative market reactions but can be positive for a neighbouring country despite suffering heavy losses to its citizens. This is something to consider when conducting this study along with determining if there has been an increase in

market resilience due to terror attacks, which unfortunately, have become all too common in society.

4.2.3 Natural Disasters

Over the past few decades there have been numerous natural catastrophes that have broken records in terms of destruction, cost, and unfortunately, fatalities. One of the biggest disasters occurred in 2005, as Hurricane Katrina made landfall and caused USD$150 billion in damage. (Mahalingam, Coburn, Jung, Yeo, Cooper & Evan 2018)

Given the scale and unpredictability of a natural disaster occurring, the size, and resulting implications to the economy, it has led to an increasing number of studies examining the impacts on various markets, although most tend to focus on either specific sector such as insurance, construction, and real estate or on a domestic level.

Most of these studies find that natural disasters have a negative effect on market returns and markets react to the bad information almost immediately. They use a range of methodologies including the GARCH method and event studies, the latter being the most common. (Shelor et al. 1992, Yamori & Kobayashi 2002, Odell & Weidenmier 2004, Worthington & Valadkhani 2004, Yang et al. 2008, Li 2013, Tao 2014)

Both Angbazo and Narayanan (1996) and Yamori and Kobayashi (1994) examine the impact on the insurance industry, in which they find that natural disasters are largely negative in terms of property-liability insurers. Angbazo examine the impact on Hurricane Andrew in the United States and find large negative effects on insurance stocks, which was reduced somewhat by smaller positive effects caused by the recouping of some premiums paid insurance holders.

Worthington and Valadkhani (2004) investigated the impact of natural disasters on the Australian stock market. Their paper examined daily and accumulated returns from 1982 to 2002 on and their reaction to 42 natural disasters. They found that earthquakes had a mixed response on market returns.

And more recently in 2013, Li (2013) examines the impact of a range of natural disasters on the Australian market. Her study uses an event study methodology using the data on daily returns of samples firms that are categorized into a variety of industries that include insurance, mining, construction, and transportation. She finds that natural disasters that occurred in Queensland during 2005-2011 had evident negative effects on the Australian equity market with the net effects across industries either being positive and/or negative. Furthermore, she found that these effects had been felt two days prior to the event which was caused by prior weather disclosures.

Another body of literature that exists with less predominance are studies examining the impact of natural disasters on aggregated markets. (Cutler et al. 1989, Lee et al. 2007, Ramiah 2013, Ferreria and Karali 2015, Koerniadi et al. 2016)
They examine numerous natural disasters with their results being reminiscent of those found by Cutler, Poterba, and Summers (1989), in which noneconomic newsworthy events had a relatively small effect on aggregated stock market returns. Moreover, Lee, Wu, and Wang (2007) analysed the contagion effect across international financial markets one to three months after the South-East Asia Tsunami in 2004, finding little effect during the first month, but over the coming months, reactions were greater.

Ramiah (2013) analysed the effects of the 2004 Indian Ocean Earthquake and Tsunami on world stock markets. They analysed 12 countries to test if international markets experienced spill over effects. Their conclusions did not find any significant impact on market returns of the equity portfolios examined. In addition, they examined the effects five days after the event, to account for any market delays, and found minimal changes in returns.

Ferreria and Karali (2015) analyse the impact of the largest 24 earthquakes that occurred over the last two decades on the returns to the aggregate stock market indices of 35 different financial markets using a GARCH-1 (1,1) model. The model was used to investigate the impact of earthquakes on abnormal returns and on stock market volatility. The event period was kept relatively small, examining the effects In the immediate aftermath of an earthquake occurring, justifying the shorter period as they attribute the markets to be relatively efficient and therefore the impact of the

Earthquake should be reflected in the stock prices almost immediately. They found that the financial markets were rather resilient to earthquakes in 34 out of 35 markets over the five days ensuing an Earthquake, with Japan having evidence that domestic earthquakes increased the volatility of their financial returns.

And finally, a recent paper by Koerniadi, Krishnamurti and Tourani-Rad (2016) examined the impact of natural disasters had upon market returns of several industries. They study a range of natural disasters which include Earthquakes, Hurricanes, Tornados, Floods, Tsunamis, and Volcanic eruptions, occurring in various developed stock markets. Their purpose was to examine the effect of these catastrophes on the market returns and specific sectors and whether they are negatively or positively affected given the previous literature having various conclusions. Their analysis finds that natural disasters do have a negative effect on certain markets and sectors in which earthquakes, hurricanes, and tornados having a prolonged, negative affect on market returns several weeks after the events, whilst other disasters such as floods, tsunami's and volcanic eruptions having a limited impact on market returns.

5 EVENT STUDY METHODOLOGY & DATA

5.1 Event Study Methodology

Today, event studies are a common research method used within the finance and economics in which the initial conception that we use today can be attributed to the early works of Fama and French (1969) and Ball and Brown (1968). Their pioneering studies have paved the way in a research methodology which has expanded into a rich and diverse body of literature which contributes immensely to the understandings and implications of economic events and corresponding investment decisions in which they effectively examine the hypothesis of whether a market is efficient, or in other words, the Efficient Market Hypothesis (EMH).

An event study, in elementary terms, attempts to investigate and examine whether an unanticipated or anticipated event has influenced financial market prices whilst ultimately testing whether the market is efficient or inefficient at adjusting to the new information quickly. Furthermore, there use can also be to investigate the perceived direction and magnitude of an event, along with longevity of such an event upon the market, which ultimately tests the market participants confidence and resilience. These uses and more are why event studies have become an important tool for researchers over the decades and continue to be used in a variety of ways to this very day.

Early studies in accounting and finance that attest to the importance and significance an event study can contribute to academia and the wider community are two papers written by Ball and Brown (1968) and Fama, Fischer, Jensen, and Roll (1969). These revolutionary studies at the time investigated how stock prices adjusted to new information to determine whether there was any significance in the events being examined. Their findings came off previous literature in the field that examined successive price changes, in which there was evidence that independence of price changes did coincide with an efficient market, or that financial markets reacted rapidly to new information. (Mandelbrot 1966, Samuelson 1965).

Ball and Brown's 1968 paper investigated accounting information of annual income releases and how stock market prices reacted to these announcements. They found that a negatively perceived announcement, in terms of income forecasting errors, had a positive impact on the abnormal returns at the time an annual report was announced.

A year later, Fama et al. (1969) examined how the market reacted to the news of stock splits and found that the announcement of stock splits was quickly absorbed on the market, thus indicating that the market adjusted to the new information and therefore signalling that the markets were indeed, efficient.

Following these two groundbreaking studies, there have been an endless abound of literature on event studies examining the reaction in the markets to a variety of events, be they firm specific events, microeconomic events, or macroeconomic events. The possibilities of an event studies scope are only limited to the imagination of the researcher with an almost limitless abode of events, factors, and other variables that can be examined in an event study.

The unintended consequence of Fama's methodology being so effective in many circumstances has led to an increasing amount of literature examining the existing body of event studies and the importance of a sound framework in which the techniques used are reliable and verifiable, given that with other methodologies, there are always issues or limitations, and this is no different when conducting an event study.

A paper by Kothari and Warner (2007) examines the econometrics of event studies with a focus on the design and statistical properties in conducting this research methodology. Given event studies are so widely used given their simplistic and flexible design by the research, they offer commentary on how one should undertake a study, relevant to its purpose. and ensuring that we produce a statistical reliable and critical event study that can be repeated if necessary.

Given the flexible nature mentioned previously in conducting an event study and its relatively simplistic design and framework, conducting such a study can often differ

substantially depending on the research goal and preference of the author. This can result in its own challenges and limitations. After becoming familiar with a wide range of methods with extensive reviews on the methodology provided in such papers by Binder (1998), Bowman (1983), Corrado (2011), Kothari and Warner (2007) and Peterson (1989) with their corresponding analysis and commentary on key papers, we find that the framework introduced by Campbell, Lo, and MacKinlay (1997) will be the most appropriate for this study to implement in which we will examine sound research questions to test within a framework that considers the limitations that may be present.

Campbell et al. (1997) suggest a seven-step framework in conducting a successful event study which includes identifying the event (1), formulating a selection criterion of the firms to be used in the study (2), calculating the normal and abnormal returns (3), identifying an estimation period (4), testing procedure, which are defining the null hypothesis, aggregating abnormal returns (5), and then presenting the empirical results(6), and interpreting such results with a concluding summary (7).

The remaining section will delve the first five steps in more detail and how they have been implemented in this study and conclude with a detailed description of the data used throughout the study. Regarding steps six and seven, there will be a dedicated section in Chapter 6 that will present and interpret the empirical results.

5.1.1 Step 1. Defining the Event

Firstly, to identify the event, there needs to be an event day or time the news announcement or event took place which will be referred to in the analysis as Event Day or Day 0.

In an event study analysis, the event date is not necessarily the calendar date that the event occurred and as such defining an event date should be based on the research questions and target of the study along with the variables and considerations of the events selected for the study.

For example, Li (2013) defined the event date as the next trading day following a natural disaster making landfall. She justified this modification given that natural disasters are often unpredictable in terms of damage, loss of life, or specific location and therefore delay was almost certain. Alternatively, other studies select an event day immediately following an event such as firm specific events that are easily identifiable. (Ball & Brown 1968, Fama et al. 1969)

Accordingly, defining the event date in this study needs to consider these factors and for the purpose of this study and the nature of the events examined having a clear date in the occurrence and impact, we have selected an event day that will occur on the calendar day of the announcement. Moreover, as we aim to examine the market reaction to an event and gauge the market efficiency of an event occurring, be it a positive or negative reaction, having an immediate event day is the deemed most appropriate.

Another issue to consider when obtaining event dates is to acquire enough events whilst minimizing validity and reliability errors. To do this, a selection criterion will be needed. Any event that occurs during a national public holiday or other cultural event will need to be disregarded, given that the financial markets of that country will be closed. Exceptions of this rule will be when closures of the market are a result of the event itself, such as the September 11 terror attacks which closed various markets around the world as a result.

Furthermore, it is important to determine if there are any events overlapping one another or that occur within close proximately to one another which might contaminate the sample within the event period or in the estimation window, with the latter being discussed later in this section.

If there were an overlap occurring this might alter the findings of the events significance due to the added noise and bias from the other event. This might in turn provide insights or even a create a Type I or Type II hypothesis error in which we find an event to be significant, when without the contaminated event, the significance would be absent and vice versa in the other instance.

Now that we have accounted for all the above and the event day is determined, we must ensure that the accuracy and reliability of each event date used within the analysis is correct. Misinterpretation or misreporting of an event date could potentially affect the results, especially during a short-period event study where we want to look at a small window of time an event occurs and how the markets respond accordingly. To ensure the accuracy of the event date, all events in this study are obtained from credible, verifiable, and reliable sources. Each event was cross-checked with multiple sources to confidently obtain an accurate event date for each of the 19 announcements/events selected, see Table 1, using Yahoo Finance, Thomas Reuters DataStream, Global Terror Database, along with various news articles and research papers.

Table 1 –List of the 19 Events Selected for this Study

N	Event	Category	Date
1	Tequila Crisis	Financial Crisis	20/12/1994
2	Russian Financial Crisis	Financial Crisis	02/07/1997
3	Asian Financial Crisis	Financial Crisis	17/08/1998
4	Dotcom Crash	Financial Crisis	19/04/2000
5	September 11 Attacks	Terror Attack	11/09/2001
6	Bali Bombings	Terror Attack	14/10/2002
7	Madrid Train Bombings	Terror Attack	11/03/2004
8	Indian Ocean Earthquake & Tsunami	Natural Disaster	26/12/2004
9	London Bombings	Terror Attack	07/07/2005
10	Hurricane Katrina	Natural Disaster	29/08/2005
11	Sichuan Earthquake	Natural Disaster	12/05/2008
12	Global Financial Crisis	Financial Crisis	15/09/2008
13	Mumbai Terror Attacks	Terror Attack	27/11/2008
14	Eurozone Sovereign Debt Crisis	Financial Crisis	19/10/2009
15	Haiti Earthquake	Natural Disaster	12/01/2010
16	Töhoku Earthquake	Natural Disaster	11/03/2011
17	Boston Marathon Bombing	Terror Attack	15/04/2013
18	Chinese Black Monday Crash	Financial Crisis	24/08/2015
19	Bataclan Paris Attacks	Terror Attack	13/11/2015

A total of 19 events occurring from 1994 to 2015.

Seven financial crises, seven terror attacks, and five natural disaster were selected for this study.

Another issue which became apparent during the data collection was the timing of an announcement or event being made and determining whether the event occurred during the markets opening or not. Unlike the FOREX markets, which operate 24 hours a day, the Equities markets which are what the indices are, have a period of daily operation and close at a specific time each day. Moreover, as we use aggregated returns in terms of the BRICS and G7 nations, we also need to account for the time zones of each event and market selected in this study.

This study included several nations that are not geographically near one another which in turn means they are also not within the same time zone, with some differences between nations being over twelve hours or in other words, one market open on a Monday afternoon, with another either closed or open the following day. As such, the time difference within certain markets needs to be accounted for as events occurring in the US at 2pm during their market's operational hours, will not be the same for the markets in Japan or China, which would be closed. If this delay is not addressed, the flow of information within the markets will contaminate those nations with significant time differences, and corresponding results will be either be over or underestimated.

Given this issue, we organised all nations by time-zones and then appropriately cross checked with each of the 19 location the events took place. We then adjusted the nations closing price returns based on the immediate trading day the market is open in each sampled nation rather than the calendar day of the event announcement.

For example, an event occurring mid-day on June 6th in the US, would be the Event Day or Day 0. However, this event would not flow through and be recognised by the Japanese markets until opening day of June 7th given the time difference. Therefore, to avoid this predicament that could contaminate the results, Japans Event Day or Day 0 would be June 7th, not June 6th. As such, all the returns in this study were adjusted according to their location and time their markets were open in relation to the time the announcement or event occurred.[2]

[2] Tables can be provided on request for the time zone and market adjustments

After all the necessary steps mentioned above have been completed, with the 19 event dates finalised, a successful event study also requires a well-designed event window and estimation window as they both have potential to influence the results depending on the period selected. (Seiler, 2004)

The event window is the period of trading days preceding and/or following the event date and its purpose is to account for any predetermined reactions or delays to an event occurring. There is no consensus within the research community on how many days will offer the most favourable results as research has various purposes such as research questions and scope which require for various research methodology design and length. (Seiler 2004)

As the event period is short in this study and taking into consideration that events are absorbed quickly into the market, the choice of alternative options in selecting a duration period is limited. The influence that financial events have on the share market in which the release and acceptance of information is quicker than ever made easier by changes to the market itself such as the use of electronic trading systems and algorithms altering how announcements are released to the market reinforce why a shorter period would be more suitable for our study. (Seiler 2004)

Moreover, in relation to natural disasters, the event window should also be relatively short to avoid contaminating estimates with confounding factors following an event occurring such as those found in earthquake shocks that might affect stock market returns. (Ferreira & Karali 2015)

In addition, with the existence of internet communication that facilitates the flow of information within seconds, along with intraday trading, reaction of an event occurring to the share market reacting to this news is faster than ever, there consensus is that a shorter event window is more appropriate with Ferreira and Karali (2015) suggesting a five-day window.

Given that we also examine both emerging and developed nations in the sample, along with the geographical distance of those selected nations, the event window length at

either side of the event day cannot be too short otherwise any delay or leakage of information will not be accounted for, thus ruling out a period of one or days either side of the event occurring.

After conducting several pilot studies for the event window days, the author selects an event window ranging from five days preceding the event to five days after the event date taking place, or (-5, +5). This short period should ensure a more powerful test, whilst also allowing any information leak or delays that may occur to be accounted for. (Seiler 2004)

Information leak, when identifying financial events, comes in the form of pre warning events that often occurs when there are predictions or rumours made within the media or markets one or two days before an actual event occurs such as an M&A or Earning Result Announcement, weather forecast, or even a terror threat. Ensuring an event window a few days before an event occurring ensures the study will account for any such leak of information onto the market. If leakage is not accounted for in the event study, this may give rise to misinterpretation of the actual effect of the catastrophe, causing unintentional bias or errors in the analytical results.

5.1.2 Step 2. Selection Criteria

The selection criteria determine the "firm/s" to be used in the study and can involve a lot of decisions in the type of firm used such as the characterises of its operations, location, history of prices, public or non-public and so on. This study differs slightly, as we examine the national indices, rather than the traditional firm level, along with eventually aggregating the indices into two groups, BRICS and the G7. This makes the selection criteria rather simplistic given that there are only a set number of countries in each category.

The first group that will be examined against the 19 selected events will be the emerging nations, specifically, the BRICS nations of Brazil, Russia, India, China, and South Africa. The second group will comprise the top developed nations of the G7 nations, at the current writing of this paper, are Canada, France, Germany, Italy, Japan,

the United Kingdom, and the United States of America. It is important to note that the purpose of this study is to not specifically examine nations within the BRICS and G7 nations and make commentary, but rather examine the leading developed and emerging countries at the time of this paper. As such, there are events in the sample that occur when the G7 were known as the G8, with Russia being the eighth member, up until their expulsion in 2014.

With all twelve nations selected the next step is to identify their market indices that will be used to examine the reaction to the various events. These indices, along with their corresponding nations can be seen in Table 2.

Table 2 - The Event Study Nations and Indices

N	Nation	Continent	Economy	Index
1	United States of America	North America	Developed	S&P 500
2	Canada	North America	Developed	TSX Composite
3	United Kingdom	Europe	Developed	FTSE 100
4	Japan	Asia	Developed	TOPIX
5	Germany	Europe	Developed	DAX 30
6	France	Europe	Developed	CAC 40
7	Italy	Europe	Developed	FTSE MIB
8	Brazil	South America	Emerging	IBOVESPA
9	Russia	Europe/Asia	Emerging	MOEX
10	India	Asia	Emerging	NIFTY 500
11	China	Asia	Emerging	Shanghai SE A Share
12	South Africa	Africa	Emerging	FTSE/JSE

Indices were chosen based on total coverage of the equities markets in each respective nation. Most of lists indices are self-explanatory, however India and Japan's indices in this study are the NIFTY[3] and TOPIX[4] rather than the SENSEX and Nikkei that are often used. We use the NIFTY and TOPIX as the provide greater coverage of the overall market in each nation.

5.1.3 Step 3. Measuring Normal and Abnormal Returns

The literature surrounding the calculation of normal and abnormal returns is extensive with various methods being developed over the decades, see Table 3.

[3] NIFTY 500 Index represents about 96.1% of the free float market capitalization of the stocks listed on NSE as on March 29, 2019. Source: (National Stock Exchange of India (NSE))

[4] This is a measure of the overall trend in the stock market, and is used as a benchmark for investment in japan stocks. (Source: Japanese Exchnage Group (JPX))

To determine the returns of the sample stock would be in the absence of the event, normal returns need to be calculated. (Seiler 2004)
Seiler identifies four different models in the estimation of normal returns. The Mean Return model, the Market Return Model, the Proxy Portfolio Return model, and the Risk-Adjusted Model or also referred to as the Single-Index market model.

These normal returns are calculated using various models, which over time have had additional variations added to the models, especially the Market Model. A study by Brown and Warner (1985) look at three models in estimating normal or expected returns, which are all statistical models of returns and are derived purely from statistical assumptions about the behaviour of returns. These returns models being the Mean-Adjusted Returns Model, the Market-Adjusted Return Model, and the Market Model. (Dyckman, Philbrick, & Stephen 1984)

The Mean Adjusted Returns model in comparison to the Market model, only requires one parameter rather than two that the Market Model requires, along with no market returns needed. The returns are calculated by taking the average return for stock *i* during the estimation of an event study and subtracted from the stock's return during the relative event period. (Binder 1998)

The disadvantages of this method however are in the presence of event clustering, where the firms in the event study sample have dates that occur within proximity to one another. Another problem that this model can have is when a market is either on an upwards or downwards trend, the method will consequently create an upwardly or downwardly biased estimate. (Seiler 2004)

Overall, this method is relatively good at generating expected returns for stock over an event window, given its simplicity. If the sample firms have event dates that are spread apart, and the markets are relatively stable this would be a method worth considering. However, given the events used in this study are close, advanced methods used to generate expected returns would be preferred in this study.

The second model, the Market Adjusted Returns model is slightly simpler when calculating abnormal returns than the Market Model as it only involves one step and not two like the Market Model. If the Market Adjusted Returns method is selected only the abnormal returns are estimated during the event period, with no statistical parameters needed to be estimated. The Market model on the other hand would first require an estimate of parameters and then estimate abnormal returns in a second step. (Binder 1998) Furthermore, the model determines that expected firm returns are equal to the market return for that period.

And lastly the Market model, which is the most widely used in an event study and has many different variations, based on the model theory, determines the return of any given security with the return of the market portfolio and follows joint normality of asset returns (MacKinley 1997). The model is an improvement over the Mean-Adjustment Returns Model as it removes some of the return that is related to the variation of the markets return. However, this benefit will depend on the R2 of the market models regression, as a high R2 value, the higher the variance reduction of abnormal returns, resulting in larger gains.

A study by Peterson (1989) discusses another three methods used to calculate abnormal returns, which use the market model, but have slight variations. The three variations of the Market Model are the Scholes-Williams Test, developed by Scholes and Williams in 1977, the Dimson Beta test developed by Dimson in 1979, and the Capital Asset Pricing Model (CAPM), developed in Sharpe in 1964.

The Scholes- Williams Test is a variation of the popular Market Model and calculates beta by using a Scholes-Williams method. (Dyckman et al. 1984)
The procedure also estimates three OLS regressions using a T daily security returns within the estimation period of an event study. (Peterson 1989)

The Dimson Beta Model also uses an alternative technique in estimating beta like the Scholes-Williams test. Dimson (1979) develops a process of estimating parameters which avoid potential bias that can occur from using daily returns for securities with infrequent trading in the estimation of parameters.

Moreover, apart for the statistical models mentioned above, there are also economic models that can used in event studies which are the Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Theory (APT).

CAPM, developed by renowned financial economists William Sharpe and Jack Treynor in 1964, is an equilibrium model that accounts risk and return related to the stock price and is used to determine an appropriate rate of return on a selected asset.

Whilst the APT developed by Ross in 1976, is an extension of CAPM, which explains expected returns of an asset by modelling in linear function within various macroeconomic variables.

Table 3 - Summary of Event Study Returns Models

		Model	Developed by
Statistical Models			
	1	Mean Adjusted Returns Model	Brown & Warner (1985)
	2	Market Adjust Returns Model	Brown & Warner (1985)
	3	Market Model	Fama (1969)
	4	Scholes-Williams*	Schole, Myron, & J. Williams (1977)
	5	Dimsen Beta Model*	Dimsen, Elroy (1979)
Economic Models			
	6	CAPM	Sharpe & Treynor (1964)
	7	APT	Ross (1976)

*Variations of the Market Model

For this research, the Market Adjusted Returns Model is used, In which the return of any given security or index in our case, is subtracted with the return of the market portfolio or world index as a benchmark, with any remaining being the abnormal which helps the researcher evaluate the impact a certain event has on the stock market.

However, to complete this calculation, the normal return, or the expected return as it can be referred as, needs to be calculated. This considering that the abnormal return is the actual return of a firm's stock price minus the normal return of the firm over the

event window. Therefore, the normal or expected return can be expressed through the following formula. (Brown & Warner 1985, MacKinlay 1997, Corrado 2011)

$$AR_{it} = R_{it} - R_{mt} \tag{1}$$

With R_{it} representing a national index, and R_{mt} representing the global index, in this case, MSCI ACWI Index.

Given the nature of this study the author modifies the market adjusted model given that instead of a firm or given security this study is implements indices. Moreover, as the model also implements an index to benchmark against a firms/securities return, we also must modify accordingly. We use a world benchmark, MSCI AC World (ACWI) Index which covers 84% of global equities markets and therefore makes an appropriate benchmark for this studies purpose.

Furthermore, given that this study implements numerous events and national indices, the Average Abnormal Returns (AAR) needs to be calculated to determine the significance for the whole sample per event, along with AARs for all events per financial crises, terror attacks, and natural disasters categories and as such is calculated as:

$$AAR_t = \frac{1}{N} \sum_{i=1}^{N} AR_{i,t} \tag{2}$$

Where AAR_t is the Average Abnormal Return at date *t*, with $AR_{i,t}$ the Actual Return for index *i* at date *t*.

Moreover, Abnormal Returns are not significant enough to give a picture on the significance of an event occurring over a period, as the event period is over 11-days (-5 to +5), the Cumulative Abnormal Returns (CARs) should also be calculated to project the overall trend of the event and therefore we calculate as follows:

$$CAR_i = \sum_{t=T_{i+1}}^{T_2} AR_{i,t} \tag{3}$$

Which is the sum of all Abnormal Returns (ARs) over the 11-day period for index i at dates *t*

As with Abnormal Returns, with the study examining multiple events and indices, the Cumulative Average Abnormal Returns (CAARs) are also calculated to determine the events significance across all indices and all events within a given event category. The CAARs are calculated as follows:

$$CAAR = \frac{1}{N}\sum_{i=1}^{N} CAR_i \tag{4}$$

With the average of the samples total *CARs* being taken at index *i*

5.1.4 Step 4. Defining the Estimation Procedure Period

Once the event date, event period, and returns and abnormal returns have been determined, the estimation window needs to be constructed. As with the rest of the framework, the estimation period is rather flexible and there is no consensus on an exact duration and left to the researcher's discretion. The estimation can either before the event window, during the event window or after the event window, however, common practise is to have the estimation period before the event and event window to obtain a sample of returns that are deemed normal, without a significant event occurring within it. This is done so the abnormal returns we are testing can be used in conjunction with the estimation sample to determine whether our returns are indeed abnormal or expected.

The underlying motivation that the estimation period should not overlap the event window is that any overlap carries the potential risk of influencing the estimates of how the stock prices react when the event is not present. If these two periods did in fact intersect, there would be a contamination effect. (Seiler 2004)

However, the critical aspect is minimizing the overlap of the chosen event with other finance events that might produce a biased result, therefore again justifying while this study should implement a short event window and estimation period.

In retaining the tests power/strength whilst also remaining reliable and effective, a relatively short estimation period of 95 days will be selected, being -6 days to -100 days. With the 95-day period preceding the event window, this is under a year used in most research or specifically 252 trading days. This adoption is to reduce some of the issues mention in the event selection criteria in minimizing cross contamination within event windows and estimation periods with conflicting events.

Now that the specified event window (-5 to +5), Event Days (Day 0), along with an estimation period of 95 days (-6 to -100), we have the complete event study timeframe that will be used in each of the 19 events examined in this study, shown in Figure 2[5].

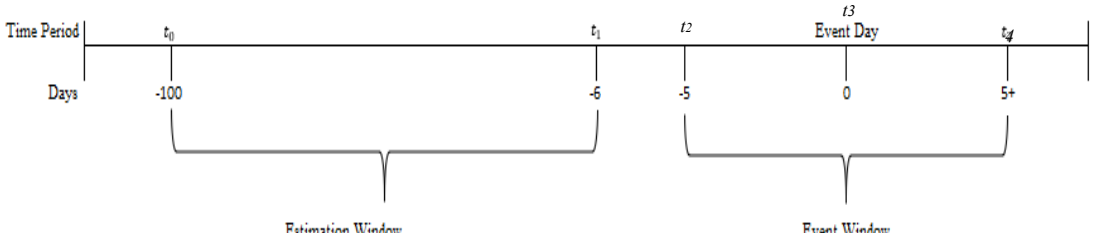

Figure 2 - Event Period Timeline

5.1.5 Step 5. Testing the Framework of Abnormal Returns

Now that the event windows, estimation period, abnormal returns and cumulative returns, we need to test abnormal returns against the chosen hypotheses in this paper to determine any statistical significance.

[5] Source: the author

Using a parametric test is deemed more appropriate in this study given the nature and scope of the study in which the t-statistic will satisfactorily measure the significance of abnormal returns. Although other nonparametric returns such as the Sign Test, Rank test and Patell tests, are also good indicators of significance but are more complex in implemented. (Corrado 1989)

The Hypothesis to be tested for each event category, financial crisis, terror attacks, and natural disasters, will be as follows:

Null Hypothesis H0: (Financial Crisis/Terror Attack/Natural Disaster) events have no impact on the BRICS and/or G7 nations market returns.

Alterative Hypothesis H1: (Financial Crisis/Terror Attack/Natural Disaster) events do have an impact on the BRICS and G7 nations market returns.

Testing these with a Null Hypothesis of $H_0: AR_{i,t} = 0$ we use the t-statistic to calculate the significance of Average Returns as:

$$t_{AR_{i,t}} = \frac{AR_{i,t}}{S.E} \tag{5}$$

Where S.E is the Standard Error equal to:

$$S.E = \sqrt{\frac{1}{(N-2)}\left[\sum_{i=0}^{N-1}(y_i - \bar{y})^2 - \frac{[\sum_{i=0}^{N-1}(x_i - \bar{x})\,(y_i - \bar{y})^2]}{\sum_{i=0}^{N-1}(x_i - \bar{x})^2}\right]} \tag{6}$$

Where *x* is a nations index and *y* the world benchmark of the sample means average (known_x's) and average (known_y's), and n is the sample size.

Consequently, we then test the Average Abnormal Returns (*AARs)* with the t-statistic for testing $H_0: AAR = 0$ at:

$$t_{AAR_t} = \sqrt{N}\frac{AAR_t}{S_{AAR_t}} \tag{7}$$

Where S_{AAR_t} is the standard deviation across indices at time *t*

$$S^2_{AAR_t} = \frac{1}{N-1}\sum_{i=1}^{N}(AR_{i,t} - AAR_t)^2 \tag{8}$$

Since we also calculate the Cumulative Abnormal Returns (CARs) along with the Cumulative Average Abnormal Returns (CAARs), their respective t-statistics will also be calculated.

With *CARs* calculated at time point *t*, the Null is: $H_0: CAR_{i,t} = 0$:

$$t_{CAR} = \frac{CAR_i}{S_{CAR}} \tag{9}$$

Where $S^2_{CAR} = L_2 S^2_{AR_t}$

And the CAARs test-statistic for testing $H_0: CAAR = 0$ is given by:

$$t_{CAAR} = \sqrt{N}\frac{CAAR}{S_{CAAR}} \tag{10}$$

Where S_{CAAR} is the standard deviation of the Cumulative Abnormal Returns across the sample at:

$$S_{CAAR}^2 = \frac{1}{N-1}\sum_{i=1}^{N}(CAR_i - CAAR)^2 \quad (11)$$

All the t- statistics in this study will use the generally accepted significance levels of 10%, 5% and 1% in which the absolute values of these levels are greater than or less than +/-1.645, +/-1.96, and +/-2.54 respectively according to the Normal distribution table and are marked in the summary tables which are in the Appendices as *, **, or ***.

A significant finding infers that markets have a reaction to a major catastrophe and therefore we reject the Null Hypothesis at a certainty of the corresponding significance level.

Once the significance of all four abnormal returns are calculated (AR, AAR, CAR, CAAR), the final two steps in conducting an event study takes place which are the interpretation of empirical results and commentary. These two steps will be discussed in Chapter 6.

5.2 Description of Data

5.2.1 Returns

The returns for this study are obtained using the various national market indexes listed in Table 4. The data was obtained using Thomas Reuters DataStream for all but Brazil's Index, which was obtained via Yahoo Finance given the Indices unavailability on DataStream. Moreover, an important aspect to clarify in relation to obtaining the data via Yahoo Finance is the reliability of the data. There have been known instances that have identified issues in data validity and the absence of returns when a holiday occurs or Yahoo Finance not considering the calendars of other nations and primarily using the US calendar which results in missing data etc. As such, the author manually

cleaned and validated the data by manually checking the returns for official holiday's and adjusting by taking the previous two days and averaging it for the missing day.

All returns obtained were the adjusted close price rather than the close price. The adjusted price accounts for stock splits and dividends and is considered by the wider academic community to be the most appropriate returns in these types of studies.

The returns for the equity indices are calculated in DataStream by calculating an aggregate sector and market price indices, along with any associated aggregations such as sector price/earnings ratio (PE) and dividend yield (DY).

$$I_t = I_{t-1} * \frac{\sum_1^n (P_t * N_t)}{\sum_1^n (P_{t-1} * N_t * f)} \tag{12}$$

Where, I_t is the index value on day t, I_{t-1} is the index value on previous working day, P_t is the unadjusted price on day t, P_{t-1} is the unadjusted price on previous day t, N_t is the number of shares in issue on day t, f is the adjustment factor for capital action occurring on day t, and n is the number of constituents in index.

Furthermore, the sector and market aggregates are weighted by market value and are calculated using the representative list of shares. KPI_0

$$KPI_t = KPI_{t-1} \frac{\sum_1^n (MV_t * ER_t)}{\sum_1^n \frac{MV_t * PI_{t-1} * ER_t}{PI_t}} \tag{13}$$

Where, *KPI* is regional price index, *MV* is country market value, *PI* is country price index, and *ER* is the country exchange rate to US dollars.

Once all the stock prices are obtained, the returns are calculated using:

$$R = \frac{ln_{(t)}}{ln_{(t-1)}} \quad (14)$$

Where, the logarithmic form *ln* of returns on current trading day *t* are divided by the logarithmic form *ln* of the previous trading day's returns *t-1*.

5.2.2 Market Exchanges & Benchmark

This study selected the major stock indices that covered most of the equities market in each of their respective markets to gain a holistic overview of an events effect on a nation's capital market. All indices were obtained via DataStream, except for Brazil, which Index returns were acquired via Yahoo Finance with the list of all the indices used in this study and information of their respective markets are presented in Table 4.

As this study implements a Market-Adjusted Model, an appropriate index is needed to determine normal and abnormal returns. In a usual firm level event study, the market index of that firm's nation is used, whereas on a simplistic study which exams a nations market response to multiple events, the S&P 500 is often used given the importance of the index on world markets. However, as thus study examined a range of events to test the reaction on the emerging and developed markets, a benchmark needs to appropriately cover the response of all economic markets.

We determine that the MSCI All Country World Index (ACWI) is implemented as the benchmark for this study as it represents a large opportunity set of large and medium-cap stocks in 23 developed[6] and 27 emerging[7] markets. Furthermore, it covers an approximate 85% of free float adjusted market capitalization in each market which we believe is an appropriate benchmark for the scope of this study.

[6] 23 developed nations of: Americas: Canada, United States: Europe: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Israel, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom; Asia; Hong Kong, Japan, Singapore; Pacific; Australia, New Zealand.
[7] 27 emerging nations of: Americas: Argentina, Brazil, Chile, Colombia, Mexico, Peru; Europe: Czech Republic, Greece, Hungary, Poland, Russia; Middle East: Egypt, Qatar, Turkey, UAE, Saudi Arabia; Africa: South Africa; Asia: China, India, Indonesia, Korea, Malaysia, Pakistan, Phillipines, Taiwan, Thailand

Table 4 - National Indices & Benchmark Summary

Nation	Exchange	Abbrev.	Index	Market Cap	Data Availability
Brazil	BM&F	BOVESPA	iBOVESPA	$804.11B	27/04/1993
Canada	Toronto Stock Exchange	TSX	Canada S&P/TSX Toronto Stock Market Index	$2.2Tr	24/05/1979
China	Shanghai Stock Exchange	SSE	Shanghai Stock Exchange Composite:	$4.39Tr	02/01/1992
France	Euronext Paris		CAC 40 Index	$1.83Tr	09/07/1987
Germany	Deutsche Borse Group	FSX	Deutsche Boerse AG German Stock Index	$2.11Tr	24/05/1979
India	Bombay (Mumbai) Stock Exchange	BSE	S&P BSE SENSEX Index	$2Tr	02/01/1991
Italy	Borsa Italiana	MTA	FTSE MIB (Milano Italia Borsa) Index	N/A	31/12/1997
Japan	Tokyo Stock Exchange	JPX	Japan Tokyo Stock Price Index (TOPIX)	$3.69Tr	24/05/1968
Russia	Moscow Exchange	MICEX	Moscow Exchange MICEX-RTS PJSC	$646.85B	22/09/1997
South Africa	Johannesburg Stock Exchange	JSE	FTSE/JSE Africa Top40 Tradable Index	$988.34B	29/06/1995
United Kingdom	London Stock Exchange	LSE	UK FTSE 100 Stock Market Index	$4.24Tr	30/12/1983
United States	New York Stock Exchange	NYSE	S&P 500 Index	$24.22Tr	24/05/1979
World Benchmark	N/A	N/A	MSCI All Country World Index (ACWI)	$56.21Tr	24/05/1979

5.2.3 Event Selection

This study examines a total of 19 events with the earliest occurring in 1992 (Tequila Crisis) and most recent in 2015 (Chinese Black Monday Crash). A summary of all events used in this study that includes a short description of each event can be found in Table 5.

Dates of each event was obtained by cross-checking with numerous media articles, insurance, and government reports, along with prior literature on these events.

Furthermore, terrorist attacks and data associated with this in the literature were obtained from The Global Terrorism Database (GTD). This database is open sourced and includes information on terror events globally from 1970 to present and included over 190,000 terror incidents.

Events selected were based on significance and impact on the global arena in which all events had a financial or socially devastating impact on multiple nations. All financial crises selected had a large impact on a variety of regions for a prolonged period, with two financial flash crashes also included, given the large losses they had on global markets and unexpected nature.

Furthermore, terror attacks were selected based on major attacks, which at the time were unprecedented in those regions. Nations that experience regular attacks become accustom to such attack according to prior research which has shown those regions and their markets largely remain unaffected.

In addition, domestic terrorism, which is when there is a targeted attack on a local population, government institute, or making a political statement were not selected for this study, as these events will primarily affect the local market of that country targeted rather than on a global level.

Finally, natural disaster events were chosen based on the destructive nature of the event, and the resulting costs and loss of life.

Table 5 - Summary of the Events Examined

	Event Name	Event Description	Category	Day	Month	Year
1	Tequila Crisis	The Central Bank of Mexico devalues the Peso	Financial Crisis	20	Dec	1994
2	Asian Financial Crisis	Thailand devalues its currency to the USD	Financial Crisis	02	Jul	1997
3	Russian Financial Crisis	Russia devalues the ruble, ruble bounds against the US can widen	Financial Crisis	17	Aug	1998
4	Dotcom Bubble	New York's NASDAQ, main market for tech firms, plunged 7%	Financial Crisis	19	Apr	2000
5	September 11 Terror Attacks	Two planes hit the World Trade Centres in NYC	Terror Attack	11	Sep	2001
6	Bali Bombings	On Saturday 12th October three bombs explode in Bali killing 202, injuring 209	Terror Attacks	14	Oct	2002
7	Madrid Train Bombings	Multiple explosions on public transport kill 193 and injury 3000	Terror Attacks	11	Mar	2004
8	Boxing Day Tsunami	At 7:58am local, a 9.1 magnitude earthquake and tsunami hit the coasts of Asia	Natural Disaster	26	Dec	2004
9	London Bombings	At 8:50am local, series of bombs on public transport kill 56, injuring 784	Terror Attacks	07	Jul	2005
10	Hurricane Katrina	What would be the costliest Hurricane makes landfall in the US	Natural Disaster	29	Aug	2005
11	Sichuan Earthquake	At 2:28 local, an 8 magnitude earthquake rocks Sichuan, killing 84,000	Natural Disaster	12	May	2008
12	Global Financial Crisis	Lehman Brothers collapses and sends markets into a freefall	Financial Crisis	15	Sep	2008
13	Mumbai Terror Attacks	Terrors attack the Taj Mahal Palace Hotel, resulting in 166 dead, +300 injured	Terror Attacks	27	Nov	2008
14	Eurozone Financial Crisis	Greece admits budget deficit double than previously estimated, or 12% of GDP	Financial Crisis	19	Oct	2009
15	Haiti Earthquake	A 7 magnitude Earthquake hits Haiti at 4:53pm local, killing +250,000	Natural Disaster	12	Jan	2010
16	Tōhoku Earthquake & Tsunami	A 9.1 Earthquake & Tsunami hits Japan & causes a subsequent nuclear meltdown	Natural Disaster	11	Mar	2011
17	Boston Marathon Bombings	At 2:49pm, two bombs detonate near the finish line of the marathon killing 3	Terror Attacks	15	Apr	2013
18	Chinese Black Monday Crash	Shanghai's SE index plunged by 8.5%, causing the Chinese markets to collapse	Financial Crisis	24	Aug	2015
19	Bataclan Paris Attacks	Coordinated terror attacks in Paris killed 130, injuring a further 416	Terror Attacks	13	Nov	2015

5.2.4 Data Validity

To avoid data validity issues and given that event studies need to have a period which account for all sample data, market closures in each respected country will need to be accounted for and then omitted from the analysis to ensure all nations are subjected to the same period. All events and market returns were obtained from reliable sources used in the wider literature.

5.2.5 Data Limitations

This study acknowledges that there are some limitations and unanticipated occurrences during the research that may affect the studies outcomes.

Firstly, the very nature of financial crises dictates that there is not one single event with the duration of a financial crisis lasting months, or even years. The "key" event day that was selected, was an event that according to previous literature and reactions around the world, was a significant negative event that would ultimately change the course of the financial crisis. However, by selecting a key event, this by no means dictates that there were no other events prior or after, that may have contributed to the possibility of noise in the datasets, such as the estimation window.

Furthermore, this study implemented a uniform event period of 11-days to gauge the market reaction across the entire event sample. However, given that financial crises, terror attacks, and natural disasters have unique and challenging circumstances, which include the duration of a certain event being prolonged or delayed. For example, Li (2013) attributes a later event day, after the calendar day, given that natural disasters take time to process on the market with mixed or inadequate levels of information available during this event.

Other limitations are within the market efficiency theory itself. As previously stated in the literature, over time, terror attacks have been shown to have reduced negative impacts on the markets have begun, some would say, to price this into the market in forms of risk.

Moreover, the limitations of the event study itself and possible anomalies seen with the literature. As the event study methodology depends on the assumption of an efficient market hypothesis. However, if this theory is not valid, as in the length of time required for individual investors to respond to event signals is random and therefore, the implication is that markets could exhibit market inefficiencies because prices do not instantly or fully reflect all available information.

Secondly, a failure to consider many other effects and variables of the event and therefore might lead to contamination by ensuing events. E.g., with the Earthquake and Tsunami in Japan, days later a nuclear meltdown occurred which could have contributed to the downturn in Japan and not the natural disaster itself. Whilst, concurrent events in different stocks might weaken or reinforce one another, resulting in abnormal returns that are not caused by the specific event of interest.

Lastly, event studies are sensitive to changes in a research design, and therefore results will vast differently depending on all the variables chosen in the event study framework, including choice of choice of benchmark, returns models, test statics and sample size.

6 EMPIRICAL RESULTS

This chapter analyses the market performance of the G7 and BRICS nations during 19 events within three categories of past Financial Disasters, Terrorist Attacks, and Natural Disasters. The 19 events examined include seven financial crises, seven terror attacks, and five natural disasters spanning a period from 1994 to 2015. The study implements the Event Study Methodology with a Market Adjusted Model applied for calculating the Abnormal Returns (ARs) and Cumulative Abnormal Returns (CARs) along with the corresponding Average Abnormal Returns (AARs) and Cumulative Average Abnormal Returns (CAARs) using the indices of each of the 12 nations against the MSCI All Country World Index (ACWI) as the market benchmark.

For brevity, the paper will primarily focus on the AARs and CAARs given the scope of this paper. It is important to highlight that to obtain the AARs and CAARs, the ARs and CARs of each individual nation within each economic group, were calculated. With the UK, US, Canada, Japan, Germany, France, and Italy's ARs and CARs calculated to obtain the AARs and CAARs of the G7. Alternatively, Brazil, Russia, India, China, and South Africa's ARs and CARs were used in calculating AARs and CAARs for the BRICS bloc. The CARs charts for all financial crises, terror attacks, and natural disasters have been included in Appendix A to provide the reader insight into how each event affected each nations index used in this study.

Furthermore, the AARs and CAARs, along with the parametric statistical t-statistics are presented in Appendix A, again for those that wish to examine the statistical implications in more detail.

Lastly, in terms of the organisation of the empirical findings and corresponding commentary and interpretation, this Chapter will be divided into three subsections based on the three categories of events examined. Those being, Financial Crises, Terror Attacks, and Natural Disaster. In addition, each subsection will discuss the overall findings of the reactions to each category and the reactions on the BRICS and G7 nations with additional commentary of individual events that had significant findings or contributed to the overall reaction of the grouping of nations reactions to

an event category. Which will correspond with the AAR and CAARs charts for each category of catastrophise to present the data visually. Given the among of analysis conducted, the full statistical analysis of each individual event in the form of the AAR and CAAR summary tables along with the t-statistics which highlight the significant findings in all 19 events have been included in Appendix B for the reader's benefit.

6.1 Financial Crisis Implications on the G7 and BRICS Economies

The seven financial disaster events examined in this paper include the Tequila Crisis of 1994, the Asian Financial Crisis in 1997, the Russian Financial Crisis in 1998, the Dotcom Crash of 2000, the Global Financial Crisis (GFC) in 2008, The Eurozone Sovereign Debt Crisis at the end of 2009, and the Chinese Black Monday Crash in 2015.

By examining the ARs, AARs, CARs, and CAARs we find that the nations domestically affected by each financial crisis demonstrate the most significance in terms of negative returns along with statistical significance, except for the United States during the Global Financial Crisis. Moreover, it has been shown over time, the contagion effect of each corresponding crisis has increased, with more nations outside the domestic region of those affected showing signs of statistically significant reactions to the various economic pitfalls and crisis' over the last three decades examined. Which are in line with studies by Brown and Warner (1985), Schoder and Vankudre (1986), Cornell and Shapiro (1986), Smirlock and Kaufold (1987), Bekiros (2014).

In relation to the developed and emerging nations, the emerging economies of the BRICS experience the most impact in terms of significance on the movements within their respective national stock markets, along with a sustained duration in comparison to the developed nations. This raises questions of whether the market is efficient in emerging markets with the results indicating that emerging markets are slower to react to new information and experience high levels of sporadic volatility which may demonstrate the uncertainty of market participants and they lack confidence.

Although, the results also indicate that the levels of shock on national indices have decreased over time in terms of the ARs examined, with the duration and volatility during the five days preceding and five days ensuing a significance negative financial event, lessening over time. This leads us to believe that markets ability to react to new information has improved over time, with market confidence of those market participants being more favourable in recent years than in the previous two decades. This finding would therefore, favour market efficiency, as Fama and McKinley indicate that daily returns are good indicators of the garnering the market's reaction to new information, and this seems to concur that over time the market have reacted to historic patterns. One might assume that as markets have become more interconnected, regardless of their economic status, the ability to share new information and more importantly, reliability of that information has contributed to the emerging markets being more efficient than had previously been possible.

Relating to the AARs of all financial crises, which aggregate abnormal returns across all seven financial crises within the BRICS and G7 nations, shown in Figure 3, both economic blocs had relatively small levels of volatility in relation to those seven financial crises examined over the three decades. However, in terms of significance, the BRICS nations did demonstrate a rather volatile trend compared with the G7's rather flat period in the 11-day period examined. Furthermore, you can see that the BRICS nations were particularly volatile pre-event period, which signifies that markets were uncertain in the days leading up to the event.

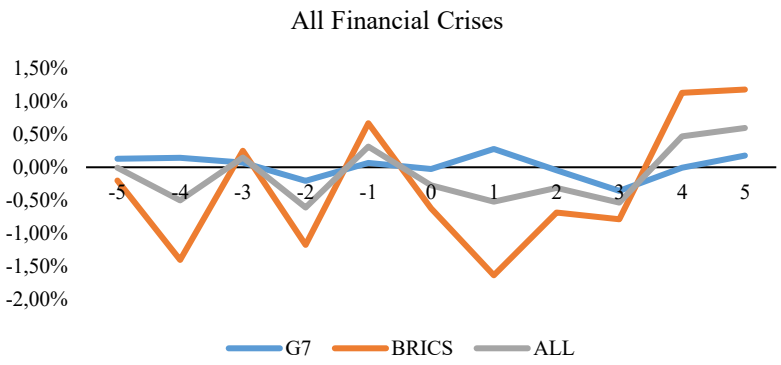

Figure 3 - AARs of All Financial Crises

Moreover, on the day of key negative announcement, Event Day 0, the G7 nations had relatively minor response overall with a drop of -0.27% on the Event Day, which was quickly recouped on Day +1 and followed by a rather uneventful trend pattern across the AARs and CAARs of the seven financial crises examined. In contrast, the BRICS, experienced a sharp decline to negative announcements on Day 0, which continued to drop on to Day +1, as investors having lost confidence in the market and the financial stability of the region. It took 4 days after the event for emerging markets to regain into positive territory.

Of the seven financial disasters examined, which can be seen in Figure 4, the BRICS nations had the most negative reactions on their national indices except for the Eurozone crisis, which surprisingly had a prolonged positive reaction during this event. There was uniform negativity in relation to an events announcement across the BRICs and G7 bloc of nations leading up to the Event Day 0, with statistical significance at the 10% and 5% levels for the Russian Financial Crisis, Dotcom Crash, GFC, and Black Monday Crash in China. Furthermore, statistical significance is greater for the BRICS nations in which they also recoup slower than the G7 over the 11-period event window examined in this study. Which as mentioned before, might attribute to the inefficiencies and instabilities of emerging markets.

Delving into the BRICS markets in more detail, Russia displayed the most reaction on average with a high level of volatility to most financial disasters within the sample of events. The most significant of which can be attributed to the high levels of negative returns during the Russian Crisis, which aligns with the literature that an event occurring domestically has greater impact on the market. There was also significant activity during the GFC. Returns significantly declined over multiple days before both event days at a significance level at the 1% level with returns far exceeding -15%, contributing to the statistical significance of all financial within the BRICS group of nations.

Alternatively, The G7 nations had relatively stable levels of returns within an overall range between -2% to +2% across all seven financial crises. This somewhat demonstrates that the developed economies examined were more resilient during those

financial disasters along with the markets reacting to negative news immediately which show that the confidence of the financial stability of those markets were able to recover faster than those of the BRICS. Again, this aligns with previously discussed literature in this paper that market participant confidence is a key factor in why the events occurring in emerging nations had more of an impact and spread rapidly across their respective continents due to low investor confidence and increased levels of panic.

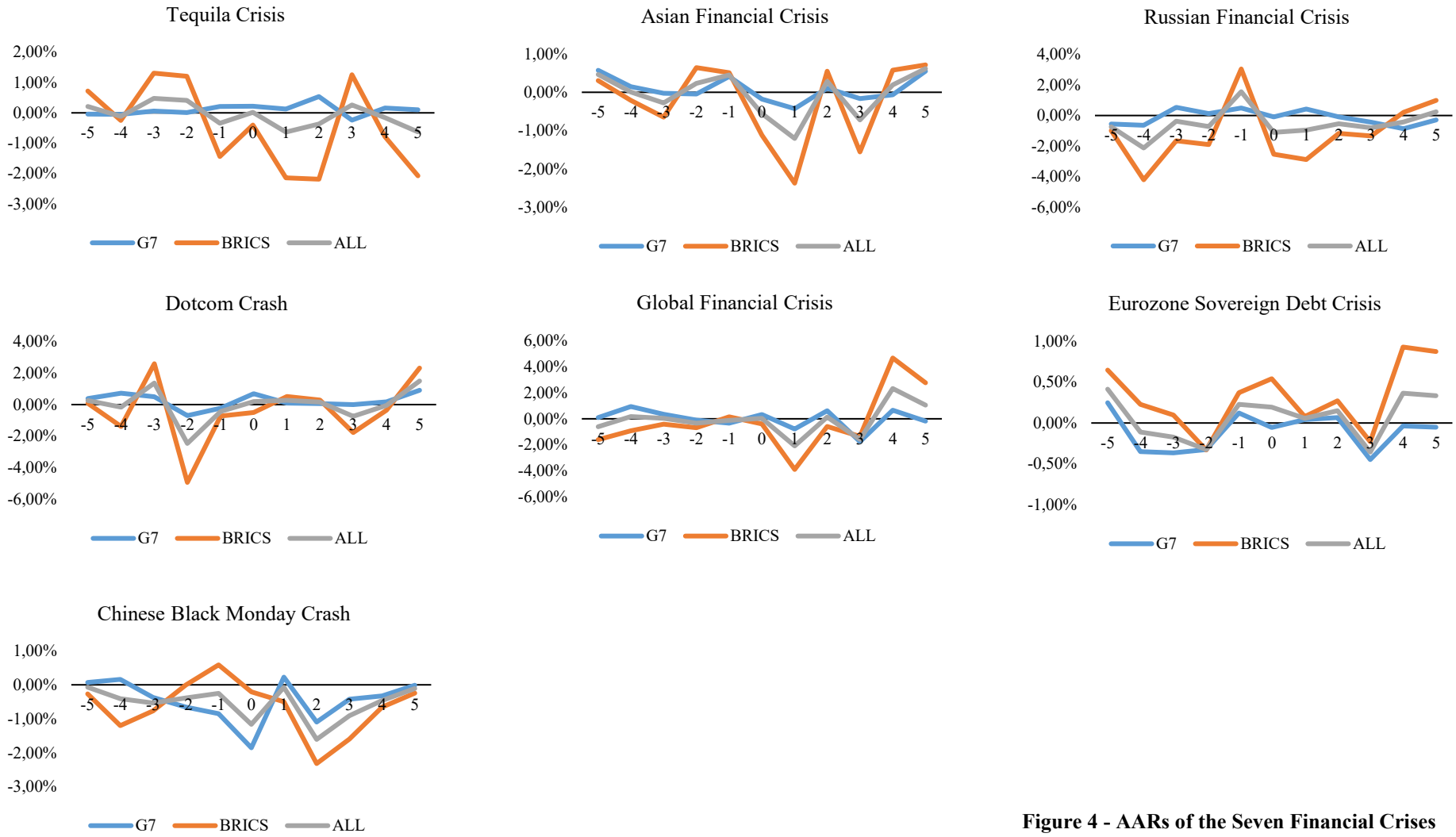

Figure 4 - AARs of the Seven Financial Crises

Furthermore, examining the CAARs of the BRICS and G7 across all financial crisis events, Figure 5 indicates that the average reaction to negative announcements made in relation to a financial crisis, saw developed nations faring substantially better and were considerably more resilient, having the least impact on their financial markets than their emerging nation counterparts. Furthermore, market volatility and the extent of a significant negative economic event occurring was also minimal in the developed nations. As the chart shows, on Event Day, the BRICS nations had a negative reaction to the announcement with a peak downturn on three days after the events occurring, only showing signs of recovery thereafter. This result significantly impacted the overall sample of all nations as seen in the grey line of the chart. This is important for investment diversification, as many portfolios have a combination of both developed and emerging markets, which in this instance, would mean an overall negative effect to a balanced economic portfolio during a financial crisis. Although we do acknowledge that risk is already priced in given that emerging markets greater returns for their increased risk.

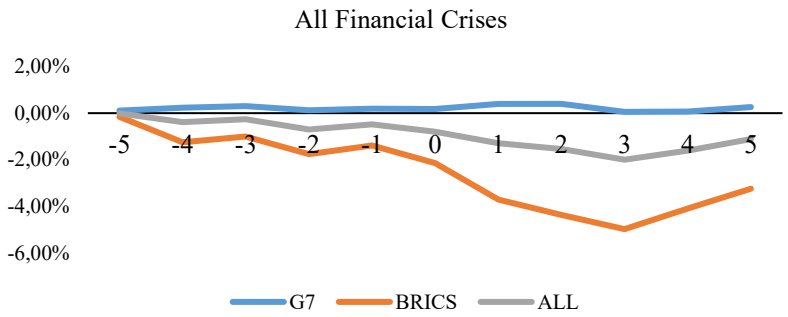

Figure 5 - CAARs of All Financial Crises

Having a closer examination of each financial crisis and the reaction of the BRICS and G7 to each announcement dates, there seems to be a clear indication that the developed nations were relatively stable, with minimal signs of volatility than those of the BRICS. During the Tequila Crisis, Russian Crisis, Asian Crisis, Dotcom Crash. Global Financial Crisis, both the developed and emerging countries experienced similar patterns in relation to a negative announcement being made to the markets. See Figure 6.

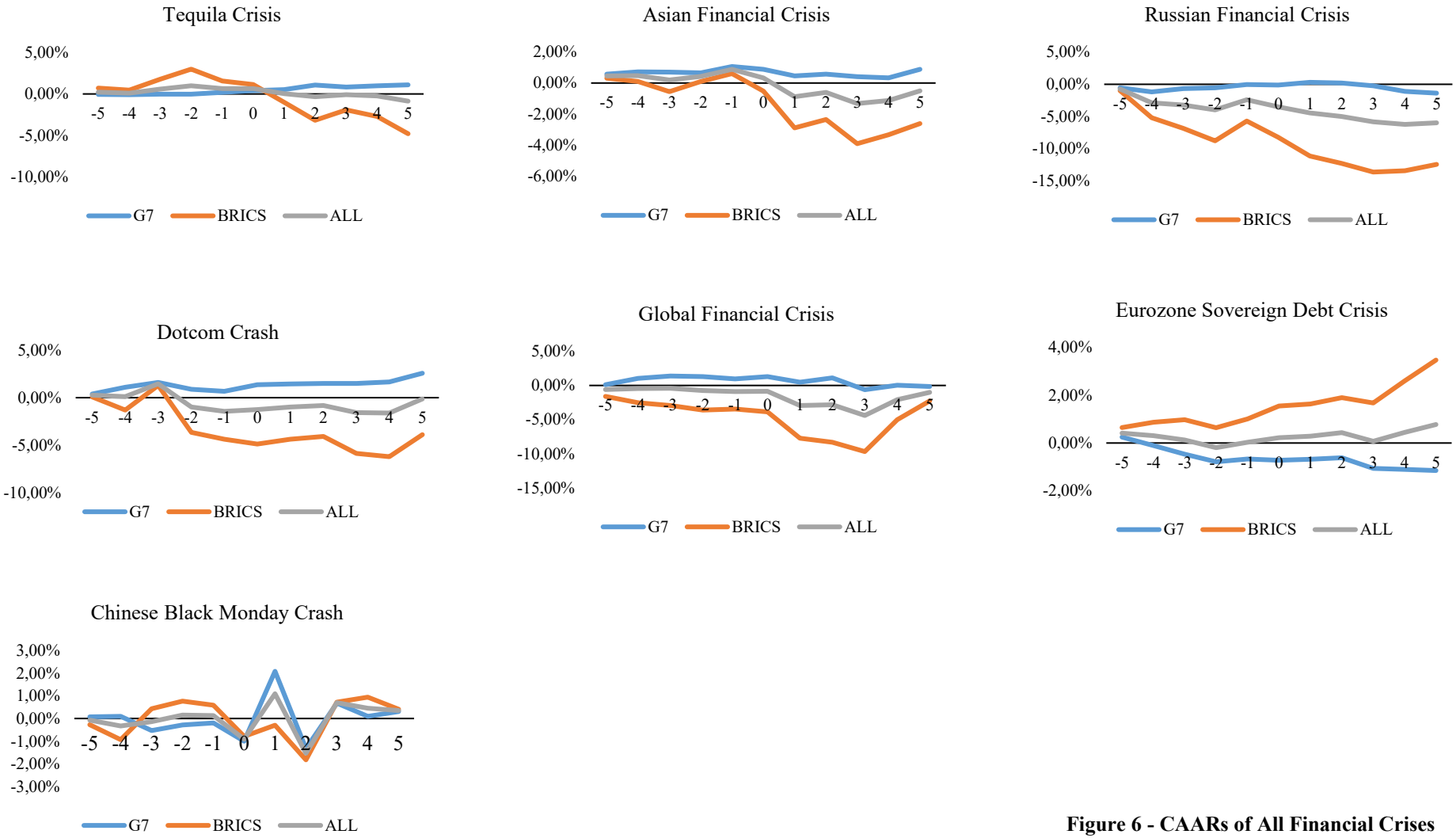

Figure 6 - CAARs of All Financial Crises

During the Tequila Crisis, the developed nations had a relatively mild positive reaction in contrast with the BRICS nations which saw a decline from two days prior to event day which continued until three days after the event, with a short one-day increase followed again by decreases ending at day +5 with an average CAR of -6%. No statistical significance was found. Prior research on financial calamities of the early 1980's, such as studies undertaken by Fama, show the financial crises occurring in Latin American had a level of contagion that was mainly restricted to their geographical location along with those nations that had a well-established trading partnership at that time, which in those days was not as globally connected as we see today.

Similar findings were found during the Asian Financial Crisis of 1998 with this study finding no statistical significance within the G7 nations over the 11-day period, whereas the BRICS nations had an adverse reaction starting on the Event Day 0 which carried throughout the five corresponding days. The emerging economies reacted heavily to the events in South-East Asia with China and Japan contributing to the market drops on Event Day 0. China had the most significance at the 1% level, with Japan at the 10% and 5% levels.

Moreover, China's CARs in percentage terms were relatively high throughout the period, ranging from -4% up to -19.65% on day +3 whereas Japan had significantly less with -4% or below. However, statistically, there were no levels of significance and the author may attribute this to the sampled nations examined where the crisis predominantly affected South-East Asia that had close trading ties rather than those of the North-West nations of China and Japan. This result is significant in terms of examining the difference between two nations that are geographical close, within the area the financial crisis originated, but differ in terms of economic status and development at the time. The reaction to the event and the relatively smaller reaction show that the developed economy of Japan weathered the crisis more efficiently than China. This finding is in line with past literature that emerging countries are more volatile and react at a greater level of significance than developed economies.

Moreover, in terms of the financial events that had the most significance was the Russian Financial Crisis which occurred one year after the Asian Crisis, and The GFC a decade later and saw both developed and emerging nations negatively affected. Although, as with the previous crises, the emerging economies fared worse. The Russian Financial Crisis showed large levels of statistical significance across the G7 and BRICS bloc of nations, with the BRICS nations having the most reaction to Russia's currency devaluation compared with much of the EU nations in this study. Russia suffered substantially, suffering as high as -41.50% (day +4) with statistical significances throughout days -4 to -2 and +2 to +5 at the 1% level far exceeding t-statistical values of over. This aligns with the literature that domestic reactions are far greater in terms of volatility and market reaction. Moreover, all emerging nations except India, recorded heavy losses over the 11-day period with high levels of statistical significance at the 1%, 5%, and 10% levels.

Conversely, the only significant market reaction to the Russian crisis in the developed sample, was Canada. The North American nation had significance prior to the event day -4 at 1% significance, and at the 5% and 10% levels from +3 days until +5 days. Although after further research, Canada was also experiencing a decline in banking stocks, with the uncertainty of the Russian crisis adding to investor sentiment and therefore, the author attributes in part to this result.

Leading into the new millennium, the Dotcom Crash, as with previous financial calamities in this study, the emerging nations being adversely affected and at a more substantial, but not statistically significant level. Alternatively, the G7 had relatively positive CAAR returns over the period with significance three days prior to the event day. The US, Canada, and the UK suffered minor reactions at the 10% level of significance three days prior to the event day, although the CAR percentages were small at approximately 2-3%. Whereas Germany and France had no statistical significance across the period.

In relation to the BRICS nations, Brazil and South Africa had negative reactions to the event, with Brazil's statistical significance at the 10% level prior to the event day and South Africa's at the 1% level. Moreover, India's Nifty Index dropped dramatically

throughout the event window, beginning at two days prior at -6% at level of significance of 10% and continuing to drop to -21.21% on day +4 with an end to the period with a slight sign of a recovery on day +5 with -16%. Surprisingly, Russia was the only exception with no statistical significance within the event window period

Following onto the next decade, the collapse of Lehman Brothers in 2008 would become one of the most prolific financial disaster since the Great Depression. It was therefore no surprise that there were significant levels of volatility across a range of statistical significance within the BRICS and G7 nations. The emerging group of nations had an overall negative reaction to the events in the US with levels of significance at the 1% level and all continued along a negative trend until three days after with sharp jump into positive territory on Day +3.

Brazil, Russia, India, and China all experienced negative reactions throughout the event window, with Brazil having a statistical significance five and four days prior to the event day which they were able to regain much of those losses over the coming trading days. Conversely, Russia suffered significant cumulative declines over the entire period at a 1% level of significance over Days -4 to -2, and Days 0 to +5, with a loss greater than -31.78% three days after the collapse of Lehman Brothers.

These results yet again demonstrate that emerging nations suffer significantly in times of a financial calamities with prolonged exposure compared with the developed economies in the sample. The G7 nations were relatively calm over the 11-day period, with minimal reactions in terms of significance, except for a few days prior to the Event Day in which Canada had significance at the 1% level, UK at the 5% level, and France and Italy at the 10% level. Moreover, the US suffered the least in terms of CARs with no statistical significance along with small declines not exceedingly more than 2% throughout the examined event period. The findings show that no matter whether it was the emerging or developed nations, investors would have gained little from diversification during the scope of this calamity which aligns with the findings of Bartram and Bodnar (2009), and Dooley and Hutchinson (2009).

Now interesting, the last two financial crises that were examined in this study had rather surprisingly findings, in terms of the emerging economies faring fair better during the Eurozone Crisis than the G7, whilst the crash of the markets in China led to an initial drop across all regions to then see the G7 sharply return to positive territory the following day and flattening during the remainder of the period.

During the Eurozone Sovereign Credit, the G7 nations had a continual decline across the period in reaction to Greece's announcement of a black hole in their budget which would ultimately send the European markets into freefall. But despite that, there was no significance across the G7 or any seven nations within the economic group. In contrast to the decline in the G7 nation states, the BRIC nations over the 11-day period experienced a persistent upward trend, with a sharp spike on Day +3, but with no levels of significance.

Lastly, on Monday the 24th of August 2015, a flash crash in the Chinese markets surprised the market with a significant amount of activity in all major markets around the globe. As the markets in Shanghai tumbled, this was quickly absorbed by all markets, with an average decline in the G7 and BRICS for the trading day. Germany, France, and Italy had slight negative reactions on Event Day 0 with CARs of -3.52%, 2.83%, and -3.37% respectively. However, this was swiftly reversed on Day 1, with the G7 regaining the loss of the previous trading day, leaving no evidence of any statistical significance in the developed nation sample.

Contrarywise, China experienced a significant downturn across the event period examine. With dramatic declines on Day 0 with significance at Day -4 at the 10% level whilst Days 0 to +5 were all statistically significant at the 1% and 5% level. In terms of a contagion or spill-over in the surrounding region, there was minimal evidence of contagion in India and South Africa with both nations reacting positively on Event Day 0 with South Africa having a significance level of 1%. Russia and Brazil also had positive gains throughout the period, with Brazil having a CAR as high as 6% on Day +4 with a mixture of statistical significances of 1%, 5% and 10%. Interesting, Japan, a developed nation, reacted negatively to the event with CARS within the -4% to -5% range between day 0 and day +5 with significance across Day 1 to day 3.

6.2 How the G7 and BRICS Markets React to Terrorist Attacks

The seven terror attacks examined in this paper include September 11 terror attacks in 2001, Bali Bombings in 2002, Madrid Train Bombings in 2004, London Bombings in 2005, Mumbai Taj Mahal Palace Attacks in 2008, Boston Marathon Bombing in 2013, and Bataclan Paris attacks in 2015.

Examining Figure 7, we find that in relation to AARs, the developed nations have an initial negative response to terror attacks in which those nations directly affected suffer the most, whilst other nations within the G7 suffer similar effects on their markets. Interesting, the BRICS nations experience a slight delay, with a sharp drop on Day +1. Moreover, both the BRICS and G7 economies experience small levels of volatility days after the attacks as returns move back into positive territory on Day+2 but fall again, with less movement, on Day +3.

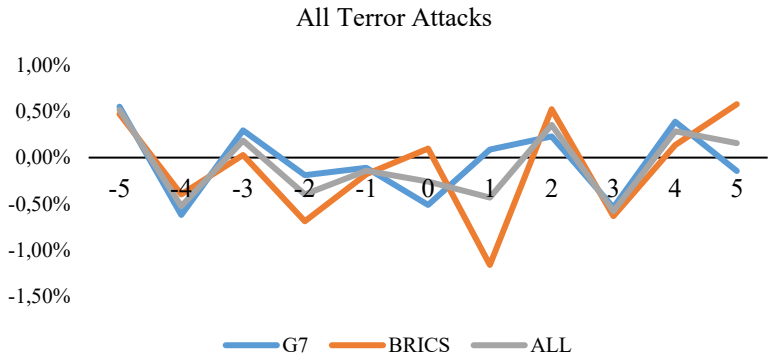

Figure 7 - AARs of All Terror Attacks

Examining the CAARs of all the terror attacks in Figure 8, paints a clearer picture at the accumulated movement across the 11-day period. There is a clear indication that all markets react negatively to a terror attack, with the BRICS nations having a considerably worse reaction than those of the G7 and for a prolonged period. However, over the sampled seven events and across the BRICS and G7, there was no statistical significance across the 11-day period.

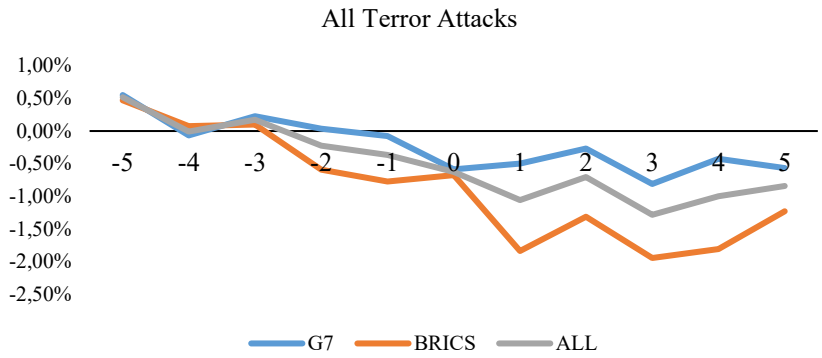

Figure 8 - CAARs of All Terror Attacks

Furthermore, as we examine each terror attack inflicted in the sample, there seems to be no correlation or pattern in terms of market activity across BRICS and G7 and as such each event will be analysed separately as we discuss the AARs and CAARs for each terror attack shown in Figures 9 and 10 at the conclusion of this section's commentary.

6.2.1 September 11

As discussed in the previous literature, the number of studies examining terror attacks increased significantly after September 11, which saw the worst attack on the West in recent memory. During this unprecedented event, the G7 nations in terms of AARs had an initial negative reaction on Event Day with most markets rebounding on Day +1, which was followed by a further drop on Day +3 by 2%. Moreover, the BRICS nations saw a delay to the event with a significant decrease on Day +1. The terror attack led all nations to a negative spiral after the event day, with some level of recovery on day +4. This event had statistical significance for the G7 nations at the 1% from Event Day up until the end of the selected period of Day +5, whereas there was less statistical significance for the BRICS at the 10% level on Days +1 and +5, at the 5% level on Days +2 and +4, and the 1% on Day +3.

Moreover, the CAARs saw The G7 having the most severe reaction to the event with the European nations of Germany and Italy having statistical significance from Day 0 to +5 at the 1%, France with 1% on Event Day 0 and +3 with an additional 5% level

on Days +1 and +2. Interestingly, the US or Canada showed no statistical significance with CARs in the positive region of 2-3% after the event occurring. These results, we believe, may be because of the markets closure for the rest of the week in the US and Canada. Because of this anomaly, the study in the future should use a greater event window to attribute this phenomenon. In terms of the emerging economies, Brazil and India had negative reactions, with Brazil at the 1% significant level over the five days, whilst India having 5%. Russia and South Africa had no statistical significance, whereas China had positive CARs throughout the 11-day period, climbing to as much as 8.93% on day +5 with 1% statistical level.

6.2.2 Bali Bombings

The second terror attacks occurred in Bali in which several bombs tore through the busy tourism district, which was originally targeted towards American nationals, but resulted in the deaths of primarily Australian and British tourists along with local Indonesians. The AARs obtained show a rather volatile period with a relatively large shock to the BRICS markets on Day +1, followed by a steep correction the following day. This falls in line with previous papers of Carter and Simkins (2004), Chen and Siems (2004), that show markets negatively react to terrorism events almost immediately, yet recover quickly, usually within the next trading day. Furthermore, looking at the CAARs of this event, the BRICS show significant declines compared with the G7, which have steady returns over the period.

6.2.3 Madrid Train Bombings

The Madrid bombings which ripped through commuter trains during peak morning rush hour and killing 193, the highest death toll from a terror attack in Europe at that time, surprisingly saw little movements on many of the nations examined with only Germany and Brazil having negative reactions at a CAR significance level on event day at the 10% and 5% level, respectively. Moreover, on Day +1, these losses were immediately corrected at a significance of 10% for both nations. Moreover, the AARs show a smaller negative reaction on Day 0, as both the BRICS and G7 nations

recovered the next trading day, with the BRICS doing slightly better in which can be attributed to China and Russia's positive returns throughout the period.

Examining the CAARs we see an interesting contrast over the five days, with the BRICS nations having an overall cumulated average return positive, whereas the G7 nations having an adverse reaction. These findings are in contrast with Arin, Cifferi and Spagnolo (2008) who found emerging markets experience more significant shocks to their markets for longer, whilst developed nations are more resilient in times of terrorist attacks of multiple terror attacks studies.

6.2.4 London Bombings

The attacks on London which targeted the morning rush hour transportations systems saw most of the EU nations within the G7 suffer negatively on Event Day, with Germany, Italy, UK, and France showing reaction at a 5% level of significance. The US and Canada on the other hand had little reaction, whilst Japan had slight reaction with no significance. Moreover, in relation to the AARs there appeared to be minimal reactions across the developed and emerging nations, with no statistical significance on evert day or the days ensuing. Furthermore, the CAARs during the London Terror attacks show that there were relatively minor negative reactions to the event with no statistical significance. This seems to be in line with the literature that over time, terror attacks have decreased in market significance since September11 as in line with studies by Kollias et al. (2011), Chen and Siems (2004), and Arin et al. (2008).

6.2.5 Mumbai Taj Mahal Palace Attacks

The attacks on hotels in Mumbai did little to the markets of the G7 in terms of ARs whereas they had various implications on the BRICS nations. Little effect was seen on the Event Day, however on Day +1, India, China, and Brazil all had negative reactions with significance at the 5% level. Moreover, this was followed by a correction with 5% and 1% significance to India and China. Looking at the AARs and CAARs of the Mumbai terror attacks, there were relatively small negative reactions on Day +1, which quickly recovered on Day +2 with both the BRICS and G7 nations having insignificant

reactions to the event along with the five days ensuing the terror attack with no statistical significance.

6.2.6 Boston Marathon Bombings

Towards the end of the annual Boston Marathon event, two backpacks exploded in the crowd watching near the finish line, killing three people and injuring hundreds more. The event caused a significant drop on the G7 nations on Day +1 with the BRICS nations reacting positively to the news and this upward trend continued over the remaining five days of the event period. Interesting however, looking at the CAARs, the reversal happens over the cumulative returns across the 11-day period. Whereas the overall effect on the G7 market is flat, in contrast to the BRICS having a noticeable decline which peaks one day before the event. This highlights the importance of the CAARs given that the significant declines in AARs prior to the event occurring has resulted in noise/anomalies in the CAARs.

6.2.7 Bataclan Paris Attacks

The attack on the Bataclan Theatre and surrounding bars in Paris saw relatively minor reactions on global markets. On event day there were no significant movements in any of the nations examined in this study. As can be seen in the AARs, there was no significant reactions to the Event Day 0, with a slight decrease on Day +1. In relation to the CAARs, there is a positive trend across the 11-day period with a minor decrease observed on Day +1 followed by an increase on Day +2 which ended with another drop on Day +3. These finding show that the events in Paris seemed to have little effect on their overall markets, which might indicate that terror attacks have resulted in the market's resilience over the decades since the September 11 attacks, with investors no longer overreacted to these atrocities.

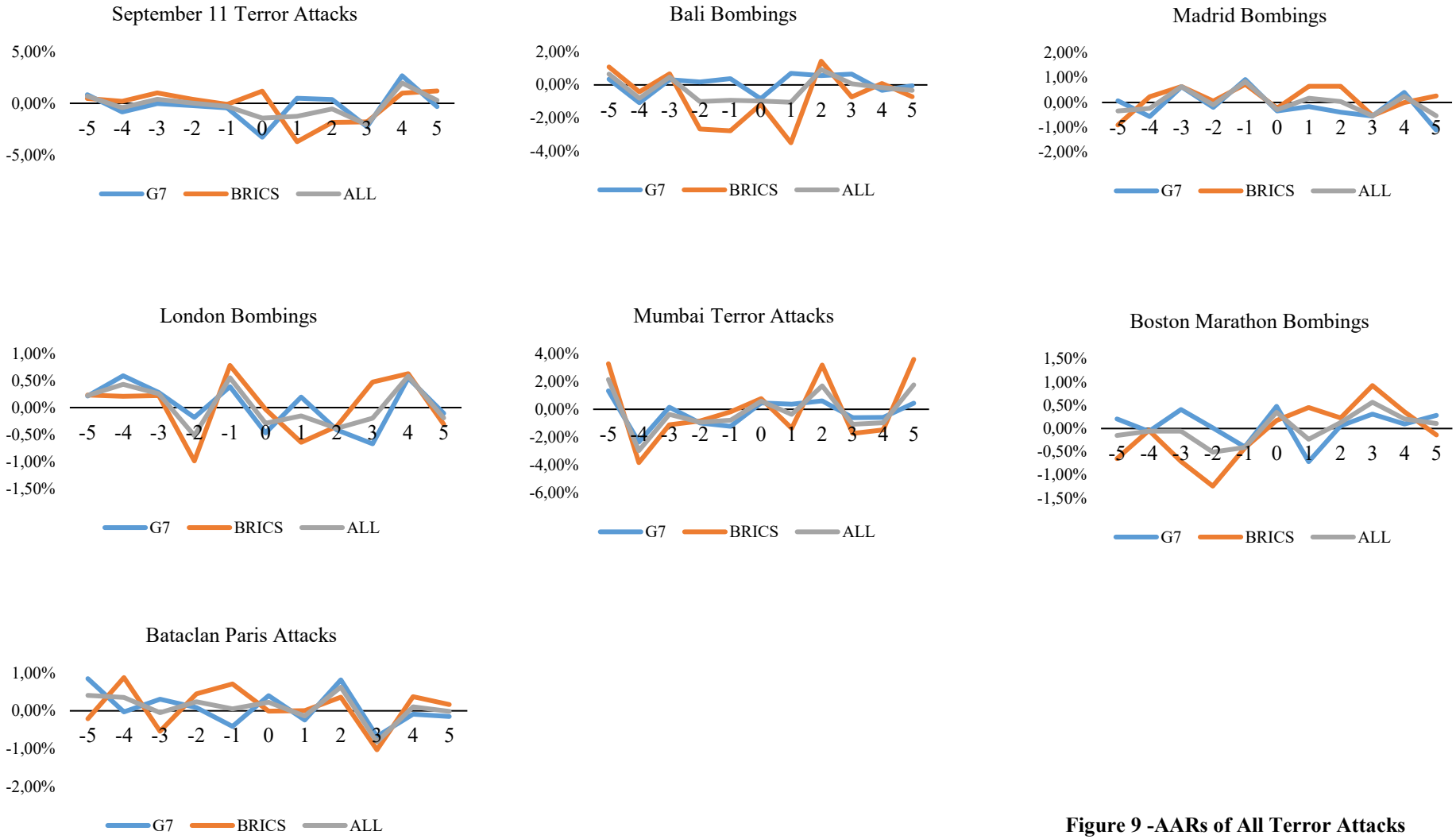

Figure 9 -AARs of All Terror Attacks

Figure 10 – CAARs of All Terror Attacks

6.3 The Implications that Natural Disasters have on the BRICS and G7

Over the past two decades there have been major natural disasters across the globe that have killed scores of people and caused record levels of infrastructure damage along with the costs associated with this. Prior literature has mainly focused on the sector implications, such as the insurance, tourism, and construction sectors rather than a market level approach. (Shelor et al. 1992, Yamori & Kobayashi 2002, Odell & Weidenmier 2004, Worthington & Valadkhani 2004, Yang et al. 2008, Li 2013, Tao 2014)

However, recently, given the extent of record-breaking disasters there have been studies examining the impact of natural disasters on within aggregate markets. (Lee et al. 2007, Ramiah 2013, Ferreria & Karali 2015, Koerniadi et al. 2016)

This paper examines five natural disasters that have caused catastrophic damages in terms of cost, infrastructure damage, and unfortunately, loss of life. The five events are the Indian Ocean Tsunami in 2002, Hurricane Katrina in 2005, the Sichuan Earthquake in 2008, Haiti Earthquake in 2010 and the Tōhoku Earthquake and Tsunami in 2011.

We find similar findings regarding aggregate body of literature, with relatively minor statistical significance found across all the natural disasters examined with little impact on all 12 markets examined, except for Hurricane Katrina in the US, the costliest catastrophe at the time, along with the Tōhoku Earthquake and Tsunami which wreaked havoc in Japan and their markets, consistent with Ferreria and Karali's 2015 study.

Examining the AARs across all five disasters, in Figure 11, the natural disasters in percentage terms have little impact on the markets across the 11-day period examined. With emerging nations showing a positive overall reaction during a natural disaster, whilst developed nations had slightly worse returns over the period, entering negative territory after Event Day 0.

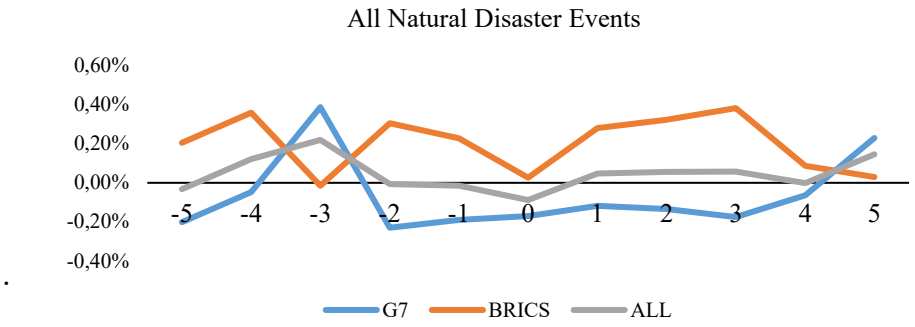

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Figure 11 - AARs of All Natural Disasters

Whereas the CAARs shown in Figure 12 demonstrate a relatively minor negative reaction of the 11-period for all the natural disasters, with Japan's reaction to Fukushima attributing to much of this. Alternatively, the BRICS nations showed a positive reaction throughout the period, however, as explained early, this was attributed to Russia's significant positive returns over four of the five natural disasters. There was no statistical significance over the 11-day period in either the BRICS, G7, or All nations samples examined.

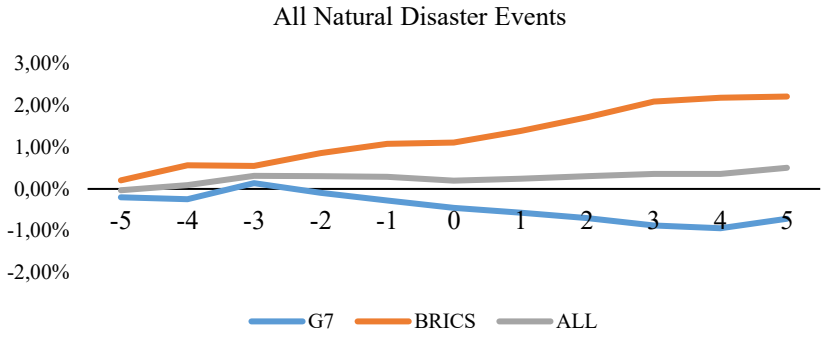

Figure 12 - CAARs of All Natural Disasters

Given the results of these events, the commentary will be limited compared with the previous categories and there being no statistical significance or reaction across the natural disasters examined in three of the five catastrophise examined. Except for Hurricane Katrina and the Tōhoku Earthquake and Tsunami which had significant reactions during the period and thus these will be explained in more detail. The AAR and CAARs of all five events can be found at the end of this section in Figures 13 and 14.

6.3.1 Indian Ocean Earthquake and Tsunami:

The Indian Ocean Tsunami or commonly referred to as the Boxing Day Tsunami, occurred in the Asian region and affected numerous nations which included Indonesia and Thailand, resulting in the death of over 200,000 people with thousands more missing from all regions of the globe.

The AARs show relatively marginal activity on the event day or days following the event, with the Russian rally on day -4, attributing to the 1.8% returns. There was no statistical significance across the 11-day period. Whilst the CAARs show that there were no significant movements across the G7 nations, and a positive trend in the BRICS nations. The positive trend in the BRICS was influenced by Russia's rally across the 11-day period, but as with the AARs, there was no statistical significance across the 11-day period. These findings are consistent with Koerniadi, Krishnamurti and Tourani-Rad (2016) study which found that floods, tsunami, and volcanic eruptions having a limited impact on market returns. Along with Ramiah (2013) who analysed 12 countries on this disaster and did not find any significant impact on market returns of the equity portfolios examined. They also examined the effects five days after the event, to account for any market delays, and as we found, minimal changes in returns occurred.

6.3.2 Hurricane Katrina

Hurricane Katrina caused widespread damage across the South West coast of the US, wreaking havoc in the city of New Orleans in Louisiana, especially. This natural disaster caused record levels of damage at that time and would take the US years to recover from the effects of this Hurricane. The AARs show that overall, the developed nations of the G7 had a minor positive reaction on event day, with slight negative reactions one day ensuing the event and into day +2 with small levels of recovery in days +3 and +4. Moreover, the BRICS nations had a minor negative reaction to the event, which was short lived with a jump on Day +1.

Across the BRICS and G7 nations, there were no statistical significance across the 11-day period examined. Whilst the CAARs demonstrate that the G7 had a general negative reaction to the event, which was mainly due to the US markets reaction which follows from past papers examining Hurricane Hugo and Katrina. Regarding the BRICS, there was a slight positive reaction but with no statistical significance across the event period examined.

6.3.3 Sichuan Earthquake

The earthquake that hit Sichuan in China in 2008 saw little reaction on world markets with small negative abnormal returns of approx. -0.50% in China, India, and South Africa.

Examining the AARs and the CAARs show relatively small movements across the 11-day period with the BRICS having slightly negative overall reaction on Day 0 and Day 1 caused by China's market reaction, with a recovery thereafter, and a large spike on day +2, which is attributed to a one-day gain in Russia of 3.15%.

Alternatively, the G7 nations had relatively minor reactions throughout the entire sample, with AARs being relatively stable, apart from Day -3, which showed an increase of approximately 1%, which was attributed to increases in the UK, German, French, and Italian markets of over 1.5%, and the Japanese market at over 2%, with significance in Italy at the 5% level.

Furthermore, the CAARs show a clearer picture of the activity of the 11-day period surrounding the Earthquake in China, with the G7 nations having minor activity with no statistical significance. The BRICS nations had an overall positive period, caused by the rallies in Russia, but did indeed see a small increase on the event day and corresponding trading day. As with the previous disasters, there were no statistical significance across the sample of nation in the 11-day event period examined.

6.3.4 Haiti Earthquake

The Earthquake in Haiti was selected as it was one of the deadliest disasters in history, killing an estimated 200,000 people. Moreover, this event which is not directly affecting any of the nations examined, which will give the samples selected a fair analysis on how markets react to an event not within their immediate region or their economic trading blocs.

Examining the AARs and CAARs, the earthquake did little to the G7 nations whereas, there was an initiative negative reaction on Event Day in the BRICS nations but led to an overall trend that was positive over the five days ensuing the earthquake.

An interest find is that the US had little reaction to the events of Haiti yet is the island's largest trading partner in terms of imports USD$1.06B and exports USD$1.39B (International Trade Administration , 2020). On the other hand, China's negative reaction on day +1, only accounts for 1.1% of Haiti's exports, but 18.8% of their imports, which might explain why the Chinese market had an initial negative reaction. (Societe Generale 2020)

6.3.5 Tōhoku Earthquake and Tsunami

The Tōhoku Earthquake and Tsunami or known in the west, known as the Fukushima Earthquake, killed over 19,000 people, and led to the eventual nuclear meltdown of numerous nuclear power reactors in Fukushima. It is important to note that the nuclear power meltdown was significant in the aftermath of the earthquake and resulting tsunami this corresponding event, the author acknowledges, might cross-contaminate the event period examined which cannot be adjusted for. (World Nuclear Association 2020)

In relation to the AARs, there was an overall positive reaction within the BRICS to the events in Japan, with no significant reaction on Day +1, and positive returns over the ensuing five days. Alternatively, the G7 nations had an overall negative response over the event day and ensuing five days with a correction into positive territory on day +3

and onward. This downturn was mostly caused by Japan's significant negative reactions to the event and days following.

Japan suffered the greatest impact on the market with the TOPEX index dropping initially on Day 1 by -1.68% and subsequently crashing through days +1 and day +2 by -6.97%, -7.68%. Interesting, on Day +3, the day the first explosion which occurred at 11.01AM the nuclear facility, the markets ended the day with an increase of +7.18%. Moreover, on day +4 the market would fall by -2.11% and then increase on Day 5 at -1.71%. (Wolchover 2011)

The US, Canada, and the UK had relatively low reactions throughout the period, although there was significance in those returns, at the 1% level, US, and Canada, and 10% level, UK. Interestingly, the US, Canada, and the UK had positive reactions on day +2, whilst Germany, France, and Italy had negative reactions. On Day +3, those positive reactions were negative, with the US, UK, Germany, France, and Italy, within the 1-2% region at a significance of 1%, the US and France, 5%, Germany, and 10%, UK and Italy. Day+4 had corrections to those loses on all nations mentioned, with Germany and France at the 10% level of significance.

Surprisingly, the only other statistical significance was in China, which had cumulative returns in the positive region throughout the event period. However, the positive cumulation can be attributed to the high ARs on days -5, and -4, at +1.45% and +2.51% respectively, with minimal movement until day +3 which was another strong market performance of +1.94 but did then see a drop in AR on day +4 of -2.42. This result demonstrates that the natural disaster of a developed nation and neighbour of China, had little impact on their markets and was one of the most interesting findings in this study. This may signify that China's economic strength and independence in the region played significance in how their national market reacted, with the nation being the second most powerful economy in the world, with the US the most powerful, and Japan being the third.

Moreover, the reaction of the market in Japan are in line with Ferreria and Karali (2015) study that found Japan's markets reacted significantly to a domestic natural disaster event.

All the findings are in line with prior findings with a report by the Nasdaq which observed the stock market reaction to the Indian Ocean Earthquake and Tsunami, Haiti Earthquake, Hurricane Katrina, and the Tōhoku Earthquake. It appeared that after every disaster, the stock market would have a small decline in a very short period and then the whole market would go up, except for the Japanese market. (Nasdaq 2011)

Moreover, a*s* with prior research, there tends to be less volatility in terms of natural disasters effects over a shorter period given the long-term effects they have on an economy. Significant losses are seen to be dependent on other factors such as whether a nation's economy is dependent on tourism, or certain industries being negatively affected whilst other sectors hedge this loss. (Worthington & Valadkhani 2004, Li 2013)

Furthermore, we find the US has had little, if any impact on any of the disasters examined thus far, along with other G7 nations, apart from Japan in relation to Earthquakes, which are in line with those found by Ferreira and Karali (2015).

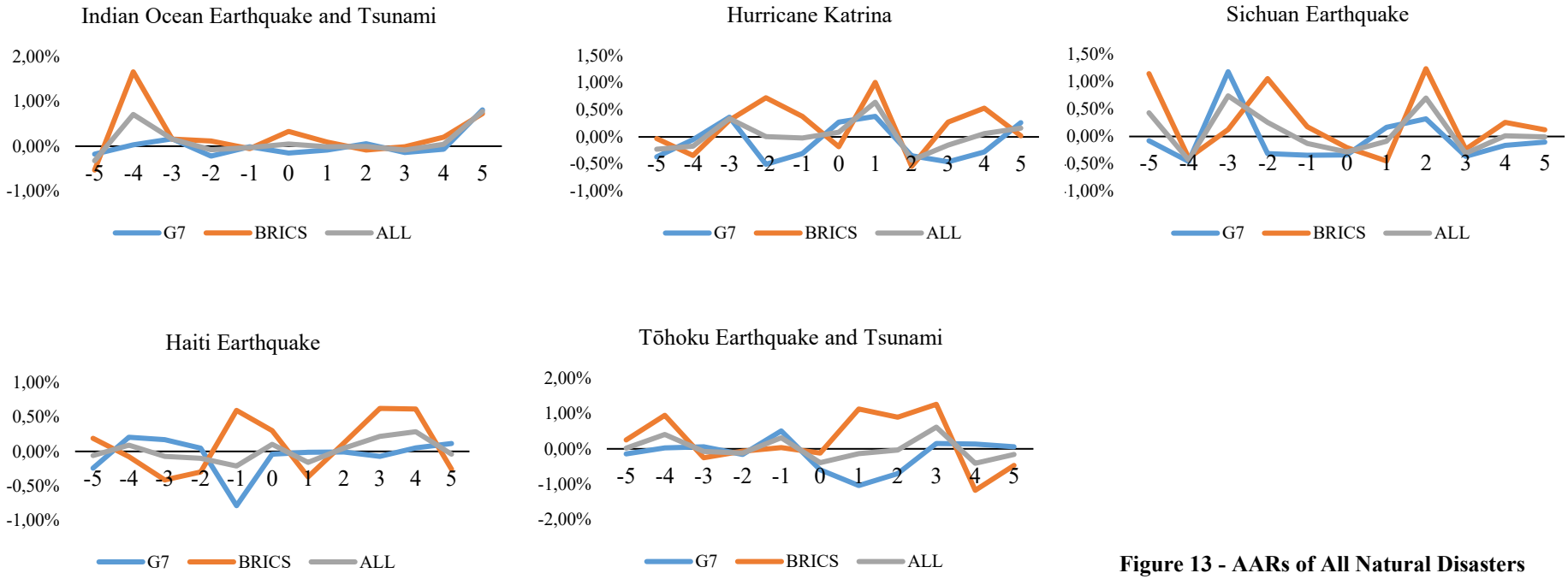

Figure 13 - AARs of All Natural Disasters

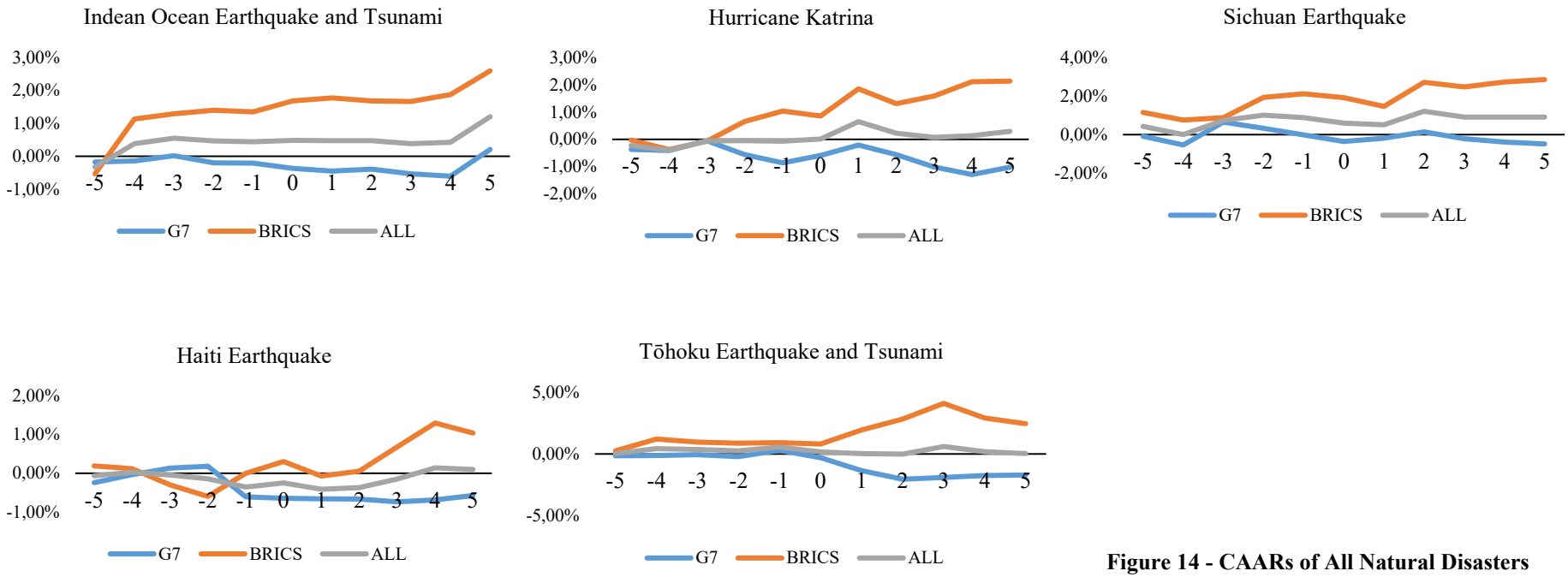

Figure 14 - CAARs of All Natural Disasters

7 SUMMARY

We employed an event study methodology to investigate the impact of seven financial disasters, seven terror attacks, and five natural disasters across 12 nations within the developed (BRICS) and emerging nations (G7).

To measure the effect of these events on their respective stock markets, this paper employs a market adjusted model using a ten-day event window, with five days preluding and five days ensuing an events occurrence. The national indices of each nation are benchmarked against MSCI ACWI, which covers 86% of the global equities markets.

We find in relation to financial crises that the nations domestically affected by each financial crisis demonstrate the most significance in terms of negative returns along with statistical significance, except for the United States during the Global Financial Crisis. Moreover, it has been shown over time, the contagion effect of each corresponding crisis has increased, with more nations outside the domestic region of those affected showing signs of statistically significant reactions to the various economic pitfalls and crisis' over the last three decades examined. These findings are parallel with studies by Brown and Warner (1985), Schoder and Vankudre (1986), Cornell and Shapiro (1986), Smirlock and Kaufold (1987), and Bekiros (2014).

Furthermore, emerging economies of the BRICS experience the most impact in terms of significance on the movements within their respective national stock markets, along with a sustained duration in comparison to the developed nations.

In relation to the seven terror attacks examined, we find that there is a clear indication that all markets react negatively to a terror attack, with the BRICS nations having a considerably worse reaction than those of the G7. However, over the sampled seven events, there was no statistical significance across the 11-day period of the BRICS nor G7.

Lastly, in the examination of five natural disasters, there is only a relatively minor negative reaction over the 11-day period for all the natural disasters with no statistical significance, apart from Japan's reaction to the Tōhoku Earthquake and Tsunami which was significant at the 1% level.

These findings are important in a corporate context, as well as for decision makers, policy makers, and market participants in gauging how catastrophic events affect the stock markets and therefore the ability to make informed decisions regarding investment diversification in alternative markets or how to reduce the contagion effect. It has also reinforced the volatility of the emerging markets and how their markets are still affected by events occurring in developed nations.

7.1 Future Direction of Research

After conducting this research and analysing the results with prior literature, we feel that expanding this topic is warranted with up-to-date analysis on events that have occurred recently which will further add to the commentary within this field. As pointed out in prior literature, there are some aspects of each catastrophic event that primarily focuses on such as industry reactions rather than indices, and heavy reliance of the US and UK's market and their effects on emerging nations. We suggest the continued study into the BRICS and other emerging nations reactions to a variety of events and developed nations as these economies continue to influence the global economic region and the future implications of understanding how they react in times of crisis is important for corporate decision makers, policy makers, and market participants.

Moreover, with the rise in costs and associated damage of natural disasters, we believe further research on this topic is more relevant than ever as climate change impacts all facets of life, be it social, economic, or political. With companies implementing and promoting more sustainable practices considering the increase in investors demand for more environmentally sustainable operations, this may in fact signal a change or evolution in how the markets reacts to a natural disaster occurring in the future. As the globe becomes more aware of the economic and environmental impact caused by

climate change with resulting increases in natural catastrophise, market participants as such might react differently to such events occurring which will alter what we have historically seen.

Lastly, with the world as connected and integrated as ever, the contagion effect that negative announcements has still signifies the need for research in the effects negative impacts in other nations has upon its neighbours and economic partners and whether the contagion effect has increased or decreased as integration between nations intensifies.

7.2 Limitations

After conducting the analysis and concluding commentary there are certain aspects within this study that might limit the results based on variables and other external factors.

Firstly, cross contamination of results occurs when multiple events occur within the same period an event occurs and might affect the results in either overestimating or underestimating the events of the examined event. This then might lead to the false rejection of a hypothesis as a result, in the worst case.

After conducting the analysis, we found two instances that might have contaminated the data which we will highlight now. The first case occurred within 2008 when the terror attacks of Mumbai coinciding with the ongoing global financial crisis. At that time, the financial crisis was wreaking havoc across most of the US and Europe and as such we might attribute some of the findings within the G7 to the financial crisis, rather than the terror attack in India.

Furthermore, as prior research has also identified, Ferreira and Karali (2015), the earthquake and tsunami in Japan had a significant aftermath event in the short days following the disaster in the form of a nuclear meltdown event that destroyed multiple reactors. Therefore, we cannot attribute the findings across the event period to the

natural disaster alone but must consider the possibility that the meltdown had some effect on the markets in Japan and across the globe.

In addition, we assume that investors are all risk neutral and rational and markets are all efficient. However as behavioural finance tells us, this might not necessarily rain true as investors might in fact act in irrational ways to the events occurring and therefore reactions and examinations of patterns may be difficult to ascertain.

Lastly, one of the limitations is the event study itself and the flexible and simplistic nature that allows the researchers to conduct an event study at their discretion. In other words, the event study allows multiple event periods, estimation periods to be used with no current consensus on a standard event period or estimation period, which may lead to bias. Furthermore, the various models a researcher can use will all provide different results along with the tests used to examine the significance.

7.3 Improvements

After conducting this study, we acknowledge that improvements can be made to further enhance the power of the analysis conducted.

Firstly, increasing the sample size of both events examined and nations would ensure a more effective and critical study along with implications of these negative events on a broader and larger sample.

Moreover, we would consider using multiple timeframes to gauge how markets have reacted over a time and determine whether there is any distinction between how a market has adjusted to these catastrophes over time, such as per decade comparisons.

Furthermore, we might implement more statistical tests such nonparametric significance tests like the Sign test, Rank test, Patell test, and Wilcoxon tests. They would provide an additional insight into the significance of the events examined, which we did not feel the need to implement in this study given the scope of this study and the complexity in undertaking such tests.

Lastly, we might use a variety of returns models along with a variation of event periods, estimation windows to gauge how these events affect the market in different scenarios.

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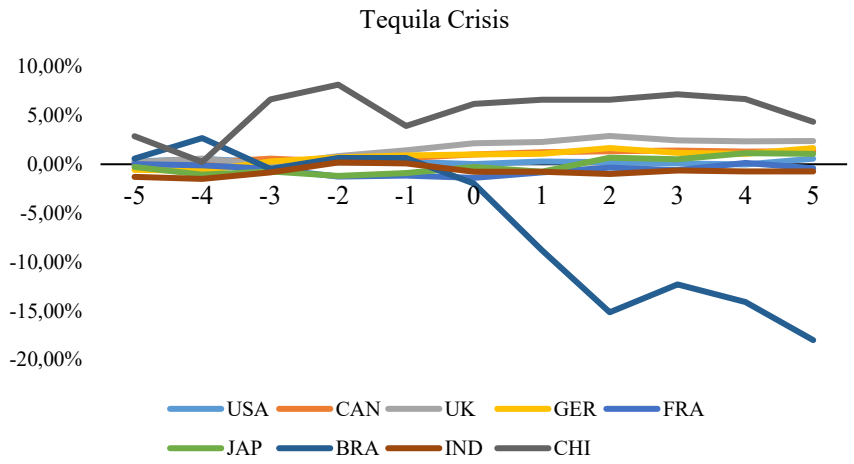
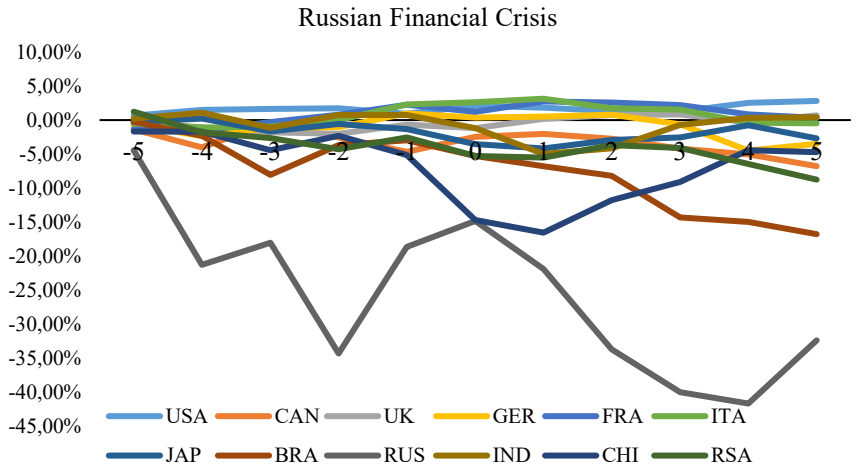
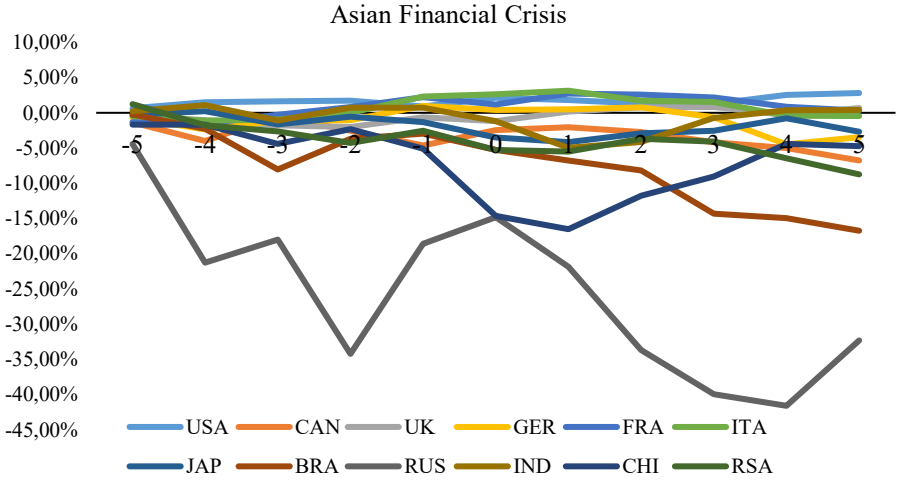
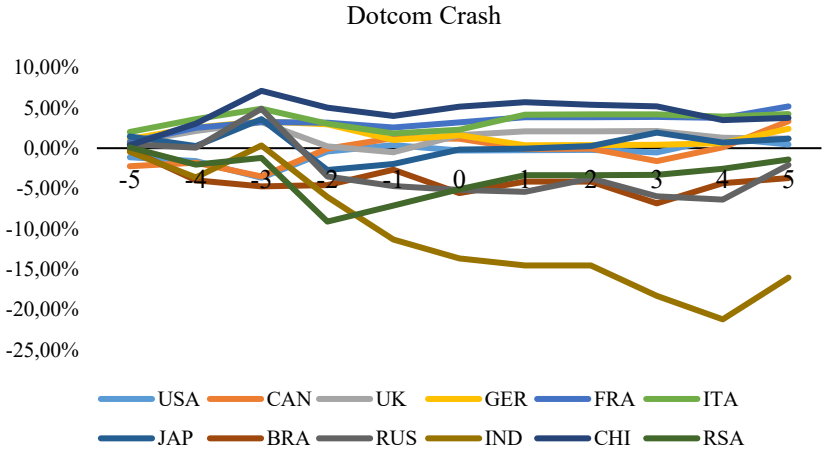
APPENDIX A –CAR CHARTS

Financial Crisis CARs

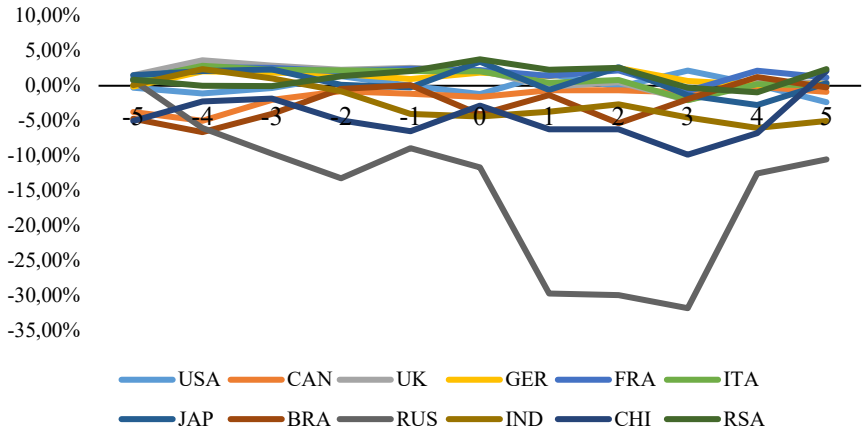




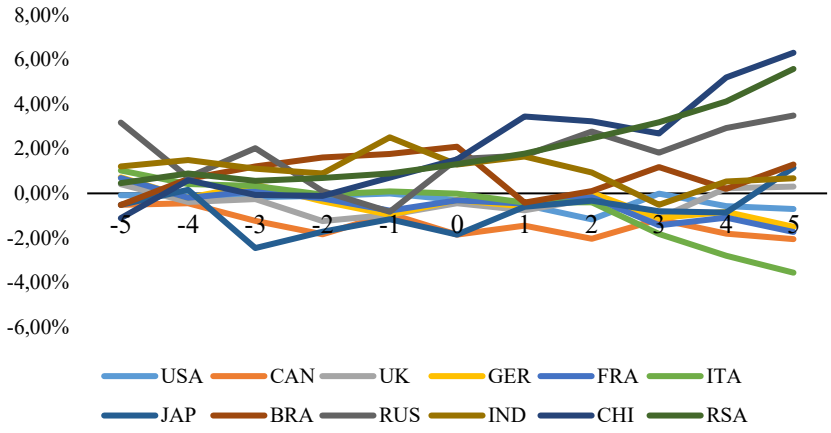




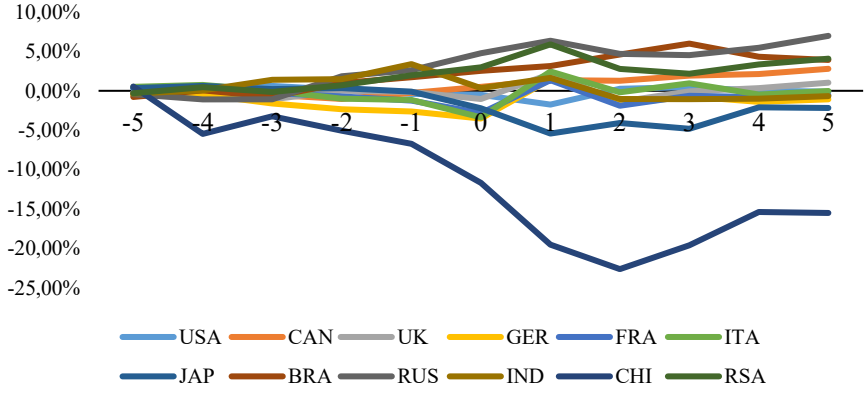
Global Financial Crisis



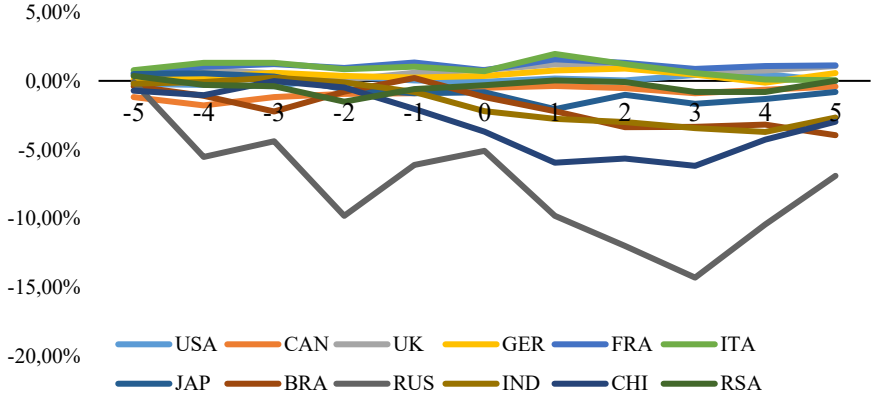
Eurozone Sovereign Debt Crisis



Chinese Black Monday Crash

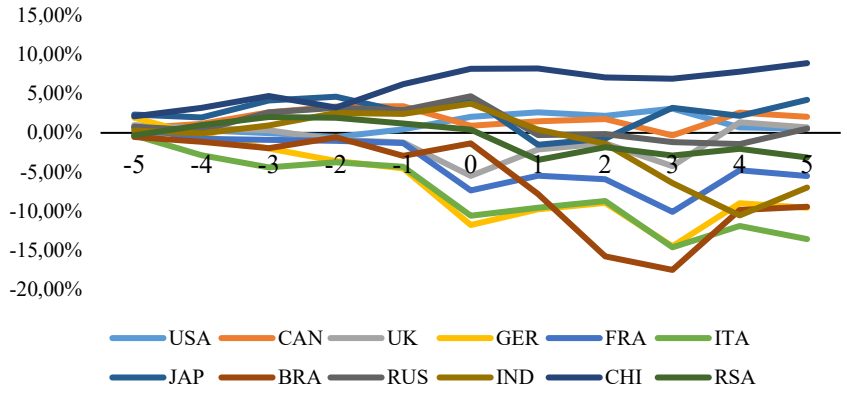


All Financial Crises

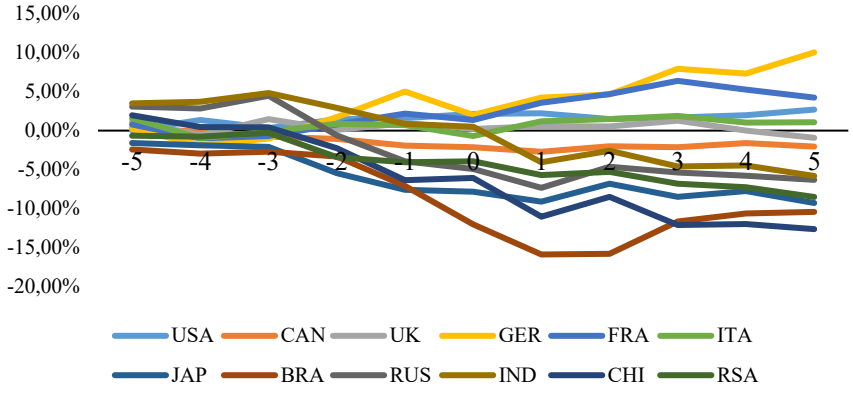


Terror Attack CARs

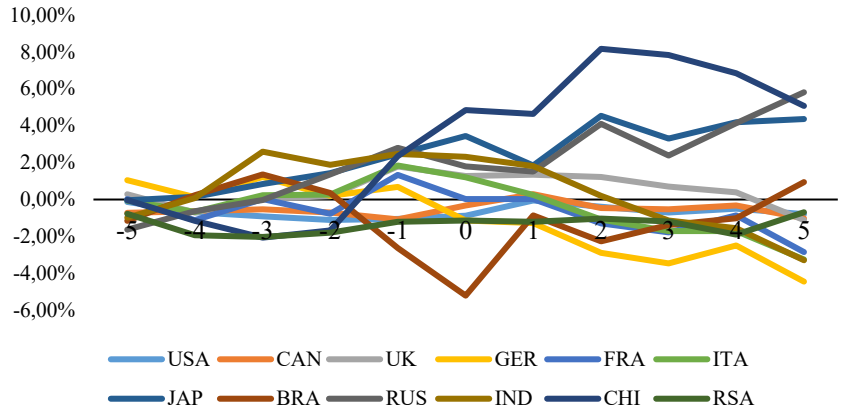
September 11 Terror Attacks



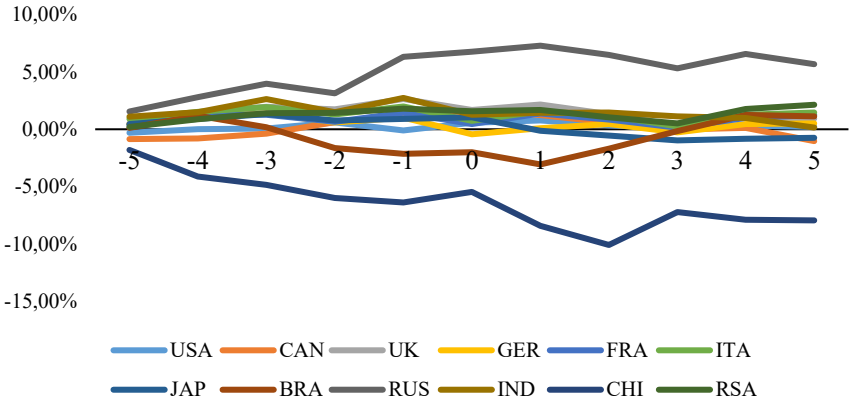
Bali Bombings



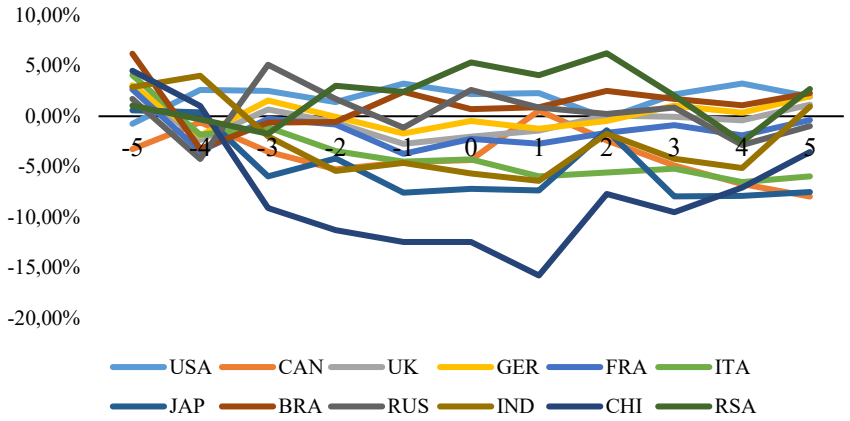
Madrid Bombings



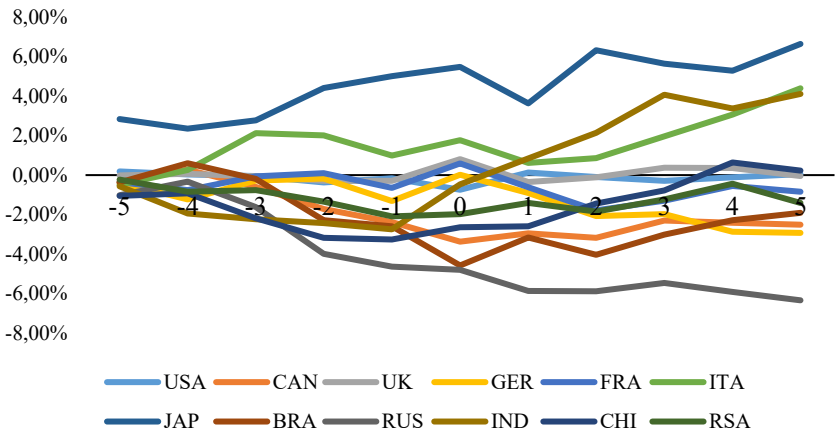
London Bombings



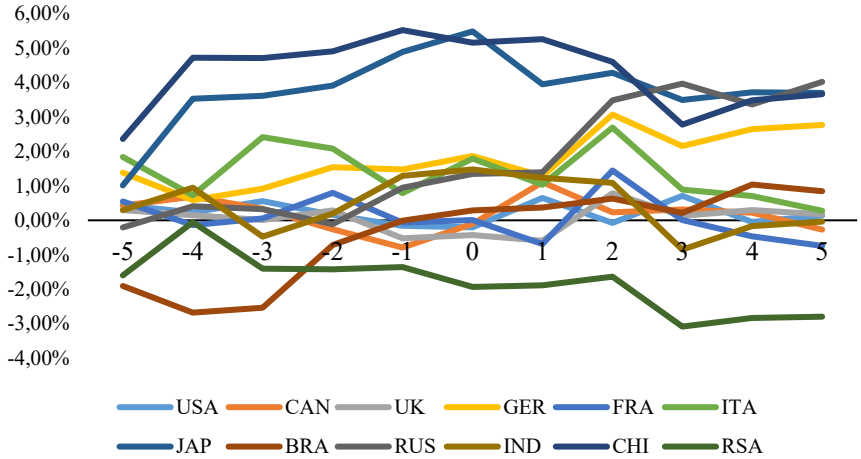
Mumbai Terror Attacks



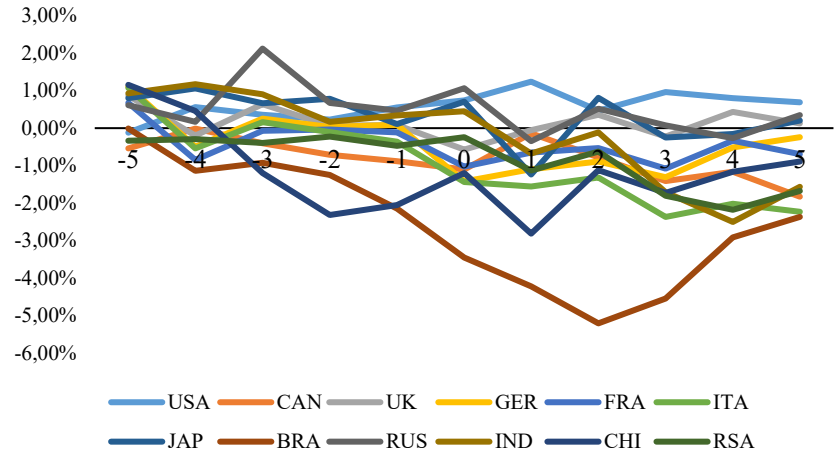
Boston Marathon Bombings



Bataclan Paris Attacks

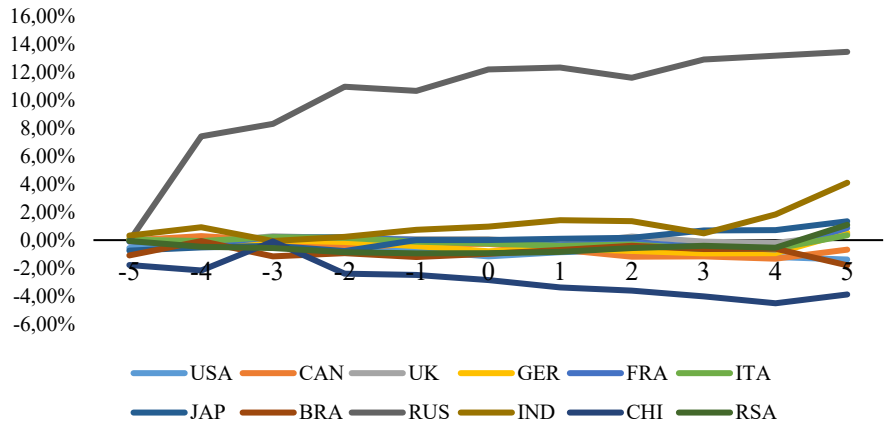


All Terror Attacks

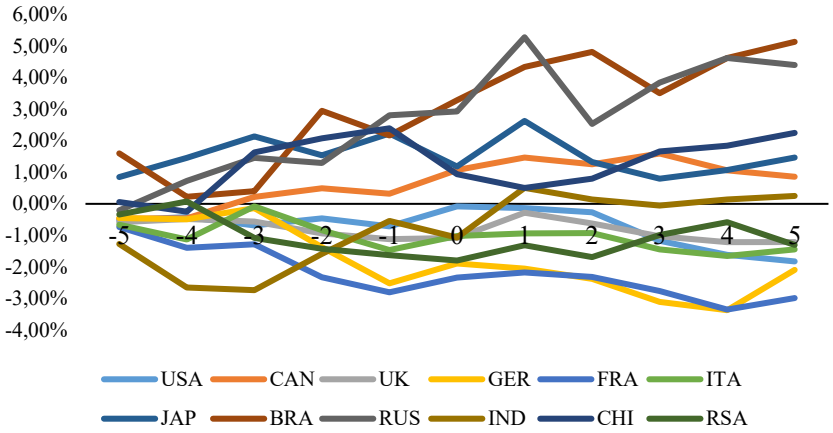


Natural Disasters CARs

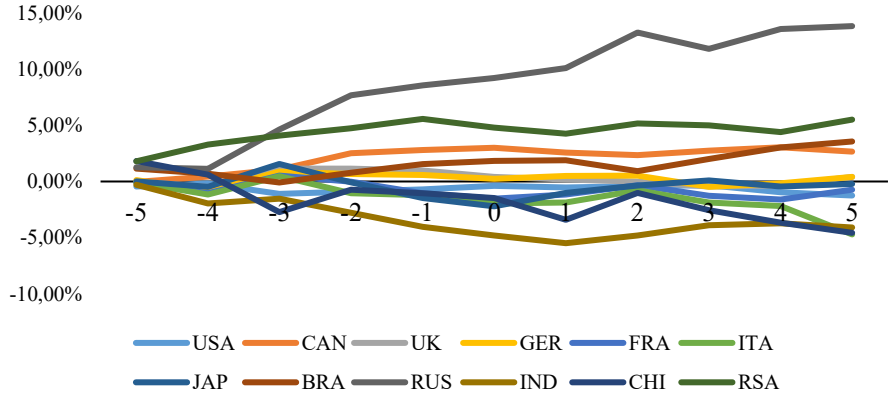
Indian Ocean Earthquake and Tsunami



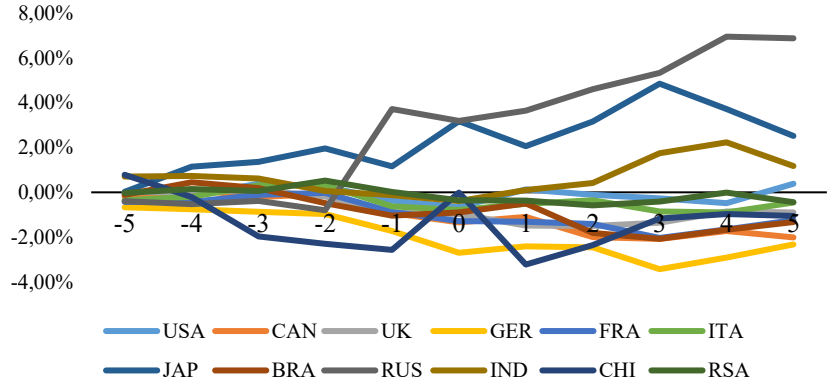
Hurricane Katrina



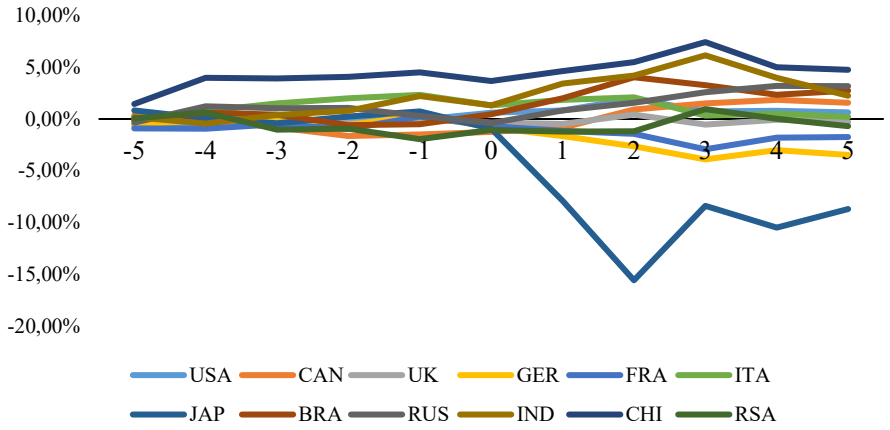
Sichuan Earthquake



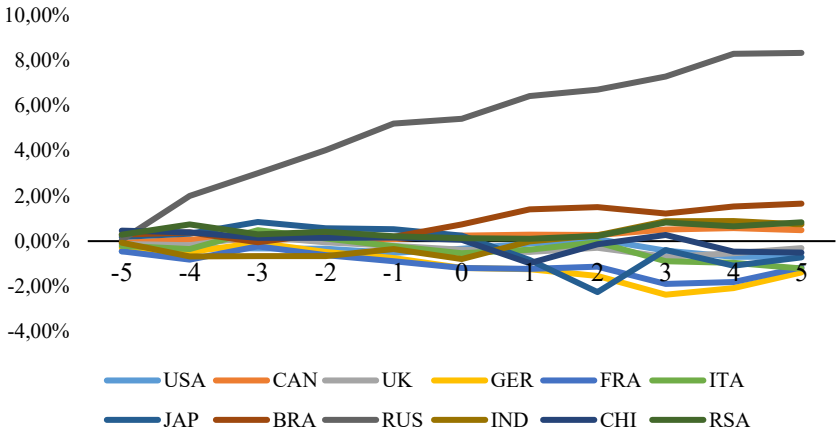
Haiti Earthquake



Tohko Earthquake and Tsunami



All Natural Disaster Events



APPENDIX B – AAR & CAAR RETURNS TABLES

Financial Crisis AAR & CAAR Returns Tables

Tequila Crisis

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	-0.04%	-0.04%	-0.0993	0.72%	0.72%	0.3353	0.21%	0.21%	0.2734
-4	-0.05%	-0.09%	-0.1509	-0.25%	0.47%	0.1549	-0.11%	0.10%	0.0892
-3	0.06%	-0.03%	-0.0371	1.31%	1.78%	0.4779	0.48%	0.58%	0.4265
-2	0.01%	-0.02%	-0.0184	1.21%	2.99%	0.6949	0.41%	0.99%	0.6327
-1	0.21%	0.19%	0.2110	-1.44%	1.55%	0.3222	-0.34%	0.65%	0.3710
0	0.22%	0.41%	0.4105	-0.40%	1.15%	0.2183	0.01%	0.66%	0.3459
1	0.12%	0.54%	0.4920	-2.14%	-0.99%	-0.1750	-0.63%	0.03%	0.0129
2	0.54%	1.07%	0.9196	-2.19%	-3.18%	-0.5233	-0.37%	-0.34%	-0.1564
3	-0.24%	0.83%	0.6731	1.25%	-1.92%	-0.2987	0.26%	-0.09%	-0.0369
4	0.16%	0.99%	0.7624	-0.79%	-2.71%	-0.3995	-0.16%	-0.24%	-0.0981
5	0.10%	1.10%	0.8015	-2.08%	-4.79%	-0.6723	-0.62%	-0.87%	-0.3352

Asian Financial Crisis

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	0.57%	0.57%	**1.6661***	0.30%	0.30%	0.3298	0.46%	0.46%	1.0773
-4	0.15%	0.72%	1.4852	-0.21%	0.09%	0.0730	0.01%	0.47%	0.7719
-3	-0.03%	0.69%	1.1676	-0.65%	-0.55%	-0.3461	-0.27%	0.20%	0.2629
-2	-0.05%	0.65%	0.9423	0.65%	0.09%	0.0511	0.23%	0.43%	0.4938
-1	0.41%	1.06%	1.3819	0.51%	0.61%	0.2945	0.45%	0.88%	0.9114
0	-0.18%	0.89%	1.0533	-1.12%	-0.51%	-0.2278	-0.55%	0.33%	0.3091
1	-0.43%	0.46%	0.5051	-2.37%	-2.88%	-1.1854	-1.20%	-0.88%	-0.7692
2	0.11%	0.57%	0.5841	0.55%	-2.34%	-0.8978	0.28%	-0.59%	-0.4863
3	-0.17%	0.40%	0.3897	-1.56%	-3.89%	-1.4109	-0.72%	-1.32%	-1.0166
4	-0.07%	0.33%	0.3075	0.58%	-3.32%	-1.1399	0.19%	-1.13%	-0.8249
5	0.55%	0.89%	0.7767	0.71%	-2.60%	-0.8527	0.62%	-0.51%	-0.3559

Russian Financial Crisis

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	-0.55%	-0.55%	-1.5805	-0.98%	-0.98%	-0.7943	-0.73%	-0.73%	-1.3508
-4	-0.64%	-1.19%	**-2.4134****	-4.21%	-5.19%	**-2.9718*****	-2.13%	-2.86%	**-3.7352*****
-3	0.54%	-0.66%	-1.0851	-1.66%	-6.85%	**-3.2014*****	-0.38%	-3.24%	**-3.4531*****
-2	0.13%	-0.53%	-0.7537	-1.91%	-8.76%	**-3.5456*****	-0.72%	-3.96%	**-3.6555*****
-1	0.50%	-0.03%	-0.0406	3.05%	-5.71%	**-2.0665****	1.56%	-2.40%	**-1.9803****
0	-0.09%	-0.12%	-0.1392	-2.53%	-8.24%	**-2.7236*****	-1.11%	-3.50%	**-2.6422*****
1	0.43%	0.31%	0.3341	-2.88%	-11.12%	**-3.4041*****	-0.95%	-4.45%	**-3.1110*****
2	-0.10%	0.21%	0.2150	-1.17%	-12.29%	**-3.5184*****	-0.54%	-5.00%	**-3.2646*****
3	-0.44%	-0.22%	-0.2133	-1.33%	-13.62%	**-3.6773*****	-0.81%	-5.81%	**-3.5770*****
4	-0.86%	-1.09%	-0.9847	0.21%	-13.41%	**-3.4358*****	-0.42%	-6.22%	**-3.6381*****
5	-0.28%	-1.37%	-1.1847	1.00%	-12.42%	**-3.0324*****	0.25%	-5.97%	**-3.3298*****

Dotcom Crash

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	0.39%	0.39%	0.6961	0.07%	0.07%	0.0577	0.25%	0.25%	0.3790
-4	0.71%	1.10%	1.4033	-1.38%	-1.30%	-0.7433	-0.16%	0.10%	0.1031
-3	0.49%	1.59%	**1.6562***	2.58%	1.28%	0.5959	1.36%	1.46%	1.2544
-2	-0.70%	0.89%	0.8050	-4.92%	-3.64%	-1.4680	-2.46%	-1.00%	-0.7418
-1	-0.23%	0.66%	0.5340	-0.72%	-4.36%	-1.5735	-0.44%	-1.43%	-0.9532
0	0.69%	1.35%	0.9927	-0.51%	-4.87%	-1.6030	0.19%	-1.24%	-0.7553
1	0.09%	1.44%	0.9798	0.52%	-4.35%	-1.3270	0.27%	-0.98%	-0.5493
2	0.06%	1.50%	0.9563	0.28%	-4.07%	-1.1606	0.15%	-0.82%	-0.4327
3	-0.01%	1.49%	0.8967	-1.78%	-5.85%	-1.5714	-0.74%	-1.57%	-0.7772
4	0.17%	1.66%	0.9474	-0.35%	-6.20%	-1.5805	-0.05%	-1.61%	-0.7598
5	0.91%	2.57%	1.3968	2.31%	-3.89%	-0.9454	1.49%	-0.12%	-0.0554

Global Financial Crisis

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	0.09%	0.09%	0.2270	-1.60%	-1.60%	**-1.7017***	-0.61%	-0.61%	-1.3016
-4	0.94%	1.03%	**1.8063***	-0.91%	-2.51%	**-1.8925***	0.17%	-0.44%	-0.6676
-3	0.35%	1.38%	**1.9704****	-0.41%	-2.92%	**-1.7945***	0.03%	-0.41%	-0.5038
-2	-0.10%	1.28%	1.5881	-0.69%	-3.60%	**-1.9201***	-0.34%	-0.75%	-0.8001
-1	-0.33%	0.95%	1.0536	0.16%	-3.45%	-1.6435	-0.13%	-0.88%	-0.8383
0	0.33%	1.29%	1.2969	-0.40%	-3.85%	**-1.6742***	0.03%	-0.85%	-0.7417
1	-0.79%	0.50%	0.4653	-3.88%	-7.73%	**-3.1121*****	-2.08%	-2.93%	**-2.3550****
2	0.63%	1.13%	0.9852	-0.58%	-8.31%	**-3.1307*****	0.12%	-2.81%	**-2.1096****
3	-1.75%	-0.62%	-0.5112	-1.35%	-9.67%	**-3.4325*****	-1.58%	-4.39%	**-3.1116*****
4	0.65%	0.03%	0.0233	4.66%	-5.01%	**-1.6866***	2.32%	-2.07%	-1.3912
5	-0.17%	-0.14%	-0.1051	2.76%	-2.25%	-0.7229	1.05%	-1.02%	-0.6541

Eurozone Financial Crisis

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	0.25%	0.25%	0.7183	0.65%	0.65%	0.8650	0.41%	0.41%	1.1104
-4	-0.35%	-0.10%	-0.2115	0.23%	0.87%	0.8270	-0.11%	0.30%	0.5765
-3	-0.37%	-0.47%	-0.7845	0.10%	0.97%	0.7515	-0.17%	0.13%	0.2039
-2	-0.32%	-0.79%	-1.1485	-0.33%	0.64%	0.4295	-0.33%	-0.19%	-0.2617
-1	0.12%	-0.67%	-0.8672	0.37%	1.01%	0.6064	0.23%	0.03%	0.0380
0	-0.06%	-0.72%	-0.8575	0.54%	1.55%	0.8490	0.19%	0.22%	0.2459
1	0.04%	-0.68%	-0.7496	0.08%	1.63%	0.8263	0.06%	0.28%	0.2851
2	0.07%	-0.62%	-0.6341	0.27%	1.90%	0.9015	0.15%	0.43%	0.4104
3	-0.45%	-1.06%	-1.0303	-0.23%	1.67%	0.7483	-0.36%	0.08%	0.0684
4	-0.04%	-1.10%	-1.0120	0.93%	2.60%	1.1032	0.36%	0.44%	0.3747
5	-0.05%	-1.15%	-1.0092	0.87%	3.47%	1.4042	0.33%	0.77%	0.6276

Chinese Black Monday Crash

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	0.07%	0.07%	0.1452	-0.27%	-0.27%	-0.3759	-0.07%	-0.07%	-0.1699
-4	0.09%	0.16%	0.2329	-0.93%	-1.20%	-1.1880	-0.33%	-0.40%	-0.6933
-3	-0.54%	-0.37%	-0.4412	0.43%	-0.77%	-0.6234	-0.13%	-0.54%	-0.7534
-2	-0.28%	-0.66%	-0.6691	0.76%	-0.01%	-0.0039	0.15%	-0.38%	-0.4656
-1	-0.19%	-0.85%	-0.7760	0.59%	0.59%	0.3681	0.13%	-0.25%	-0.2719
0	-1.00%	-1.85%	-1.5453	-0.79%	-0.20%	-0.1167	-0.92%	-1.17%	-1.1526
1	2.08%	0.23%	0.1744	-0.29%	-0.50%	-0.2625	1.09%	-0.07%	-0.0682
2	-1.33%	-1.10%	-0.7939	-1.82%	-2.32%	-1.1493	-1.53%	-1.61%	-1.3756
3	0.68%	-0.42%	-0.2889	0.72%	-1.59%	-0.7452	0.70%	-0.91%	-0.7357
4	0.10%	-0.32%	-0.2097	0.94%	-0.65%	-0.2895	0.45%	-0.46%	-0.3533
5	0.31%	-0.01%	-0.0092	0.41%	-0.24%	-0.1018	0.35%	-0.11%	-0.0796

All 7 Financial Crisis Events

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	0.11%	0.11%	0.2533	-0.16%	-0.16%	-0.1834	-0.01%	-0.01%	0.0026
-4	0.12%	0.23%	0.3074	-1.09%	-1.25%	-0.8201	-0.38%	-0.39%	-0.5079
-3	0.07%	0.31%	0.3495	0.24%	-1.01%	-0.5914	0.13%	-0.26%	-0.3661
-2	-0.19%	0.12%	0.1065	-0.75%	-1.76%	-0.8232	-0.44%	-0.70%	-0.6854
-1	0.07%	0.19%	0.2138	0.36%	-1.40%	-0.5275	0.21%	-0.49%	-0.3890
0	-0.01%	0.18%	0.1731	-0.74%	-2.14%	-0.7540	-0.31%	-0.79%	-0.6273
1	0.22%	0.40%	0.3144	-1.57%	-3.71%	-1.2342	-0.49%	-1.29%	-0.9364
2	0.00%	0.39%	0.3189	-0.66%	-4.37%	-1.3541	-0.25%	-1.53%	-1.0593
3	-0.34%	0.06%	-0.0120	-0.61%	-4.98%	-1.4839	-0.47%	-2.00%	-1.3124
4	0.02%	0.07%	-0.0237	0.88%	-4.10%	-1.0612	0.39%	-1.61%	-0.9558
5	0.19%	0.27%	0.0953	0.85%	-3.25%	-0.7033	0.50%	-1.12%	-0.5975

Terror Attack AAR & CAAR Returns Tables

September 11 Terror Attacks

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	0.84%	0.84%	**2.0428****	0.0046	0.46%	0.6135	0.0068	0.68%	1.5526
-4	-0.85%	0.00%	-0.0038	0.0020	0.66%	0.6221	-0.0041	0.28%	0.4412
-3	-0.03%	-0.03%	-0.0459	0.0101	1.67%	1.2818	0.0040	0.68%	0.8883
-2	-0.23%	-0.26%	-0.3123	0.0040	2.07%	1.3734	0.0003	0.71%	0.8082
-1	-0.44%	-0.69%	-0.7510	-0.0011	1.96%	1.1620	-0.0030	0.41%	0.4180
0	-3.28%	-3.98%	**-3.9302*****	0.0118	3.14%	**1.7005***	-0.0142	-1.01%	-0.9342
1	0.49%	-3.49%	**-3.1911*****	-0.0372	-0.58%	-0.2883	-0.0126	-2.27%	**-1.9478***
2	0.38%	-3.11%	**-2.6621*****	-0.0184	-2.42%	-1.1333	-0.0055	-2.82%	**-2.2612****
3	-2.26%	-5.37%	**-4.3354*****	-0.0180	-4.22%	**-1.8632***	-0.0207	-4.89%	**-3.6949*****
4	2.67%	-2.70%	**-2.0683****	0.0099	-3.22%	-1.3511	0.0197	-2.92%	**-2.0921****
5	-0.33%	-3.03%	**-2.2131****	0.0120	-2.03%	-0.8100	0.0031	-2.61%	**-1.7856***

Bali Bombings

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	0.35%	0.35%	0.4358	1.09%	1.09%	0.8312	0.66%	0.66%	0.8721
-4	-1.08%	-0.73%	-0.6322	-0.43%	0.66%	0.3555	-0.81%	-0.15%	-0.1394
-3	0.31%	-0.41%	-0.2930	0.68%	1.34%	0.5897	0.47%	0.32%	0.2417
-2	0.17%	-0.24%	-0.1475	-2.67%	-1.33%	-0.5084	-1.01%	-0.69%	-0.4589
-1	0.38%	0.14%	0.0764	-2.78%	-4.11%	-1.4050	-0.94%	-1.63%	-0.9652
0	-0.84%	-0.70%	-0.3530	-1.18%	-5.29%	**-1.6498***	-0.98%	-2.61%	-1.4105
1	0.70%	0.00%	-0.0004	-3.51%	-8.79%	**-2.5404****	-1.05%	-3.66%	**-1.8320***
2	0.56%	0.56%	0.2456	1.44%	-7.36%	**-1.9879****	0.93%	-2.74%	-1.2796
3	0.65%	1.22%	0.4995	-0.73%	-8.09%	**-2.0609****	0.08%	-2.66%	-1.1733
4	-0.33%	0.88%	0.3435	0.08%	-8.01%	**-1.9355***	-0.16%	-2.82%	-1.1805
5	-0.05%	0.83%	0.3079	-0.72%	-8.73%	**-2.0111****	-0.33%	-3.15%	-1.2573

Madrid Bombings

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	0.06%	0.06%	0.1757	-0.91%	-0.91%	-1.1026	-0.34%	-0.34%	-0.7953
-4	-0.57%	-0.50%	-0.9835	0.23%	-0.68%	-0.5834	-0.24%	-0.58%	-0.9494
-3	0.64%	0.13%	0.2095	0.65%	-0.03%	-0.0242	0.64%	0.06%	0.0836
-2	-0.20%	-0.07%	-0.0992	0.06%	0.02%	0.0134	-0.10%	-0.03%	-0.0380
-1	0.93%	0.85%	1.0534	0.73%	0.75%	0.4077	0.85%	0.81%	0.8433
0	-0.34%	0.51%	0.5796	-0.23%	0.52%	0.2585	-0.29%	0.52%	0.4914
1	-0.17%	0.35%	0.3627	0.65%	1.18%	0.5386	0.18%	0.69%	0.6087
2	-0.40%	-0.05%	-0.0468	0.65%	1.83%	0.7831	0.04%	0.73%	0.6032
3	-0.55%	-0.60%	-0.5497	-0.53%	1.30%	0.5248	-0.54%	0.19%	0.1497
4	0.41%	-0.19%	-0.1631	0.00%	1.30%	0.4972	0.24%	0.43%	0.3174
5	-1.11%	-1.30%	-1.0800	0.27%	1.57%	0.5713	-0.54%	-0.11%	-0.0736

London Bombings

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	0.21%	0.21%	0.6549	0.23%	0.23%	0.3897	0.22%	0.22%	0.6540
-4	0.59%	0.80%	**1.7347***	0.21%	0.44%	0.5210	0.43%	0.65%	1.3559
-3	0.28%	1.08%	**1.9053***	0.22%	0.67%	0.6382	0.25%	0.91%	1.5378
-2	-0.18%	0.90%	1.3704	-0.99%	-0.32%	-0.2660	-0.52%	0.39%	0.5723
-1	0.39%	1.29%	**1.7566***	0.78%	0.46%	0.3414	0.55%	0.94%	1.2359
0	-0.47%	0.82%	1.0186	-0.03%	0.43%	0.2894	-0.29%	0.66%	0.7840
1	0.19%	1.01%	1.1665	-0.64%	-0.22%	-0.1349	-0.15%	0.50%	0.5545
2	-0.41%	0.60%	0.6489	-0.34%	-0.56%	-0.3284	-0.38%	0.12%	0.1219
3	-0.67%	-0.07%	-0.0699	0.47%	-0.09%	-0.0493	-0.19%	-0.08%	-0.0755
4	0.55%	0.48%	0.4625	0.63%	0.54%	0.2834	0.58%	0.50%	0.4679
5	-0.11%	0.37%	0.3416	-0.31%	0.23%	0.1159	-0.19%	0.31%	0.2768

Mumbai Terror Attacks

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	1.33%	1.33%	**1.7413***	3.28%	3.28%	**1.8603***	2.14%	2.14%	**2.2137****
-4	-2.35%	-1.02%	-0.9506	-3.83%	-0.55%	-0.2212	-2.97%	-0.83%	-0.6052
-3	0.16%	-0.87%	-0.6583	-1.11%	-1.66%	-0.5449	-0.37%	-1.20%	-0.7166
-2	-0.99%	-1.86%	-1.2184	-0.84%	-2.50%	-0.7094	-0.93%	-2.12%	-1.0992
-1	-1.23%	-3.08%	**-1.8088***	-0.17%	-2.67%	-0.6789	-0.79%	-2.91%	-1.3475
0	0.46%	-2.62%	-1.4024	0.78%	-1.90%	-0.4397	0.59%	-2.32%	-0.9789
1	0.36%	-2.26%	-1.1206	-1.38%	-3.27%	-0.7023	-0.36%	-2.68%	-1.0488
2	0.60%	-1.66%	-0.7682	3.19%	-0.09%	-0.0178	1.68%	-1.00%	-0.3668
3	-0.59%	-2.25%	-0.9842	-1.73%	-1.82%	-0.3448	-1.07%	-2.07%	-0.7146
4	-0.59%	-2.84%	-1.1772	-1.48%	-3.30%	-0.5923	-0.96%	-3.03%	-0.9912
5	0.45%	-2.39%	-0.9456	3.59%	0.29%	0.0491	1.76%	-1.27%	-0.3976

Boston Marathon Bombings

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	0.21%	0.21%	0.6792	-0.65%	-0.65%	-1.3290	-0.15%	-0.15%	-0.5270
-4	-0.06%	0.14%	0.3336	-0.04%	-0.69%	-0.9997	-0.05%	-0.20%	-0.5060
-3	0.41%	0.55%	1.0523	-0.71%	-1.40%	**-1.6578***	-0.06%	-0.26%	-0.5307
-2	0.02%	0.57%	0.9374	-1.24%	-2.64%	**-2.7095*****	-0.51%	-0.77%	-1.3510
-1	-0.40%	0.17%	0.2534	-0.42%	-3.06%	**-2.8089*****	-0.41%	-1.18%	**-1.8446***
0	0.48%	0.65%	0.8781	0.17%	-2.89%	**-2.4199****	0.35%	-0.83%	-1.1813
1	-0.72%	-0.07%	-0.0820	0.45%	-2.44%	**-1.8906***	-0.23%	-1.05%	-1.3977
2	0.06%	-0.01%	-0.0100	0.23%	-2.21%	-1.6042	0.13%	-0.93%	-1.1492
3	0.31%	0.30%	0.3320	0.93%	-1.29%	-0.8787	0.57%	-0.36%	-0.4209
4	0.10%	0.40%	0.4144	0.36%	-0.93%	-0.6002	0.21%	-0.15%	-0.1715
5	0.28%	0.68%	0.6780	-0.14%	-1.07%	-0.6586	0.11%	-0.05%	-0.0501

Bataclan Paris Terror Attacks

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	0.85%	0.85%	1.5307	-0.21%	-0.21%	-0.3056	0.41%	0.41%	0.9510
-4	-0.03%	0.82%	1.0495	0.88%	0.67%	0.6812	0.35%	0.76%	1.2515
-3	0.30%	1.13%	1.1725	-0.54%	0.13%	0.1046	-0.05%	0.71%	0.9563
-2	0.09%	1.22%	1.0937	0.45%	0.57%	0.4130	0.24%	0.95%	1.1044
-1	-0.41%	0.80%	0.6463	0.71%	1.28%	0.8257	0.05%	1.00%	1.0441
0	0.40%	1.20%	0.8844	-0.01%	1.27%	0.7465	0.23%	1.23%	1.1706
1	-0.24%	0.96%	0.6546	0.01%	1.27%	0.6949	-0.14%	1.09%	0.9623
2	0.81%	1.78%	1.1307	0.36%	1.63%	0.8342	0.63%	1.72%	1.4157
3	-0.68%	1.10%	0.6605	-1.03%	0.60%	0.2903	-0.82%	0.89%	0.6945
4	-0.09%	1.01%	0.5753	0.37%	0.98%	0.4452	0.10%	1.00%	0.7343
5	-0.15%	0.86%	0.4687	0.16%	1.14%	0.4957	-0.02%	0.98%	0.6877

All 7 Terror Attacks

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	0.55%	0.55%	1.0372	0.47%	0.47%	0.1368	0.52%	0.52%	0.7030
-4	-0.62%	-0.07%	0.0782	-0.40%	0.07%	0.0537	-0.53%	-0.01%	0.1212
-3	0.29%	0.23%	0.4775	0.03%	0.10%	0.0554	0.18%	0.17%	0.3515
-2	-0.19%	0.04%	0.2320	-0.69%	-0.59%	-0.3419	-0.40%	-0.22%	-0.0660
-1	-0.11%	-0.07%	0.1752	-0.18%	-0.77%	-0.3080	-0.14%	-0.36%	-0.0880
0	-0.51%	-0.59%	-0.3321	0.10%	-0.67%	-0.2163	-0.26%	-0.62%	-0.2941
1	0.09%	-0.50%	-0.3158	-1.16%	-1.84%	-0.6176	-0.43%	-1.06%	-0.5858
2	0.23%	-0.27%	-0.2089	0.53%	-1.31%	-0.4935	0.35%	-0.70%	-0.4166
3	-0.54%	-0.81%	-0.6353	-0.63%	-1.94%	-0.6260	-0.58%	-1.28%	-0.7479
4	0.39%	-0.42%	-0.2304	0.14%	-1.81%	-0.4648	0.28%	-1.00%	-0.4165
5	-0.15%	-0.57%	-0.3489	0.58%	-1.23%	-0.3211	0.16%	-0.84%	-0.3714

Natural Disaster AAR & CAAR Return Tables

Boxing Day Tsunami

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	-0.18%	-0.18%	-0.5323	-0.53%	-0.53%	-0.8437	-0.32%	-0.32%	-0.9240
-4	0.03%	-0.14%	-0.3083	1.66%	1.13%	1.2624	0.71%	0.39%	0.7782
-3	0.16%	0.02%	0.0352	0.16%	1.29%	1.1745	0.16%	0.55%	0.9001
-2	-0.22%	-0.20%	-0.3051	0.11%	1.40%	1.1078	-0.08%	0.47%	0.6639
-1	-0.01%	-0.21%	-0.2867	-0.05%	1.35%	0.9539	-0.03%	0.44%	0.5586
0	-0.15%	-0.36%	-0.4517	0.33%	1.68%	1.0825	0.05%	0.49%	0.5647
1	-0.08%	-0.45%	-0.5148	0.09%	1.77%	1.0579	-0.01%	0.48%	0.5117
2	0.05%	-0.39%	-0.4234	-0.09%	1.68%	0.9402	-0.01%	0.47%	0.4735
3	-0.14%	-0.53%	-0.5413	-0.01%	1.67%	0.8786	-0.09%	0.38%	0.3628
4	-0.07%	-0.60%	-0.5806	0.20%	1.87%	0.9345	0.04%	0.43%	0.3832
5	0.81%	0.21%	0.1898	0.73%	2.59%	1.2374	0.78%	1.20%	1.0319

Hurricane Katrina

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	-0.37%	-0.37%	-1.1002	-0.03%	-0.03%	-0.0566	-0.23%	-0.23%	-0.6698
-4	-0.05%	-0.41%	-0.8792	-0.34%	-0.37%	-0.4693	-0.17%	-0.40%	-0.8285
-3	0.36%	-0.05%	-0.0913	0.31%	-0.06%	-0.0653	0.34%	-0.06%	-0.0975
-2	-0.51%	-0.56%	-0.8361	0.72%	0.66%	0.5857	0.01%	-0.05%	-0.0742
-1	-0.31%	-0.87%	-1.1608	0.38%	1.04%	0.8254	-0.02%	-0.07%	-0.0945
0	0.28%	-0.59%	-0.7226	-0.18%	0.86%	0.6204	0.08%	0.01%	0.0149
1	0.38%	-0.21%	-0.2399	1.01%	1.86%	1.2493	0.64%	0.65%	0.7265
2	-0.35%	-0.56%	-0.5930	-0.54%	1.32%	0.8267	-0.43%	0.22%	0.2318
3	-0.46%	-1.02%	-1.0157	0.27%	1.59%	0.9416	-0.15%	0.07%	0.0690
4	-0.28%	-1.29%	-1.2274	0.53%	2.12%	1.1919	0.06%	0.13%	0.1207
5	0.26%	-1.03%	-0.9317	0.02%	2.14%	1.1472	0.16%	0.29%	0.2593

Sichuan Earthquake

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	-0.08%	-0.08%	-0.1852	1.15%	1.15%	1.0494	0.43%	0.43%	0.7448
-4	-0.46%	-0.54%	-0.8769	-0.40%	0.75%	0.4871	-0.43%	0.00%	0.0020
-3	1.18%	0.65%	0.8641	0.13%	0.88%	0.4642	0.74%	0.74%	0.7405
-2	-0.31%	0.33%	0.3852	1.06%	1.94%	0.8838	0.26%	1.00%	0.8625
-1	-0.34%	-0.01%	-0.0104	0.18%	2.12%	0.8638	-0.13%	0.88%	0.6748
0	-0.34%	-0.35%	-0.3287	-0.20%	1.91%	0.7129	-0.28%	0.59%	0.4178
1	0.17%	-0.18%	-0.1592	-0.45%	1.47%	0.5056	-0.09%	0.50%	0.3284
2	0.32%	0.14%	0.1160	1.24%	2.70%	0.8725	0.71%	1.21%	0.7366
3	-0.36%	-0.22%	-0.1687	-0.23%	2.47%	0.7520	-0.31%	0.90%	0.5181
4	-0.16%	-0.38%	-0.2780	0.26%	2.73%	0.7872	0.01%	0.91%	0.4983
5	-0.10%	-0.48%	-0.3380	0.12%	2.85%	0.7847	-0.01%	0.91%	0.4703

Haiti Earthquake

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	-0.24%	-0.24%	-0.7749	0.19%	0.19%	0.3212	-0.06%	-0.06%	-0.1897
-4	0.21%	-0.04%	-0.0817	-0.07%	0.12%	0.1388	0.09%	0.03%	0.0601
-3	0.17%	0.14%	0.2509	-0.42%	-0.30%	-0.2889	-0.07%	-0.04%	-0.0797
-2	0.05%	0.18%	0.2905	-0.30%	-0.60%	-0.5018	-0.10%	-0.14%	-0.2199
-1	-0.79%	-0.61%	-0.8697	0.60%	0.00%	-0.0005	-0.21%	-0.36%	-0.4883
0	-0.04%	-0.65%	-0.8454	0.31%	0.30%	0.2082	0.10%	-0.25%	-0.3155
1	-0.01%	-0.66%	-0.7959	-0.37%	-0.07%	-0.0437	-0.16%	-0.41%	-0.4799
2	-0.01%	-0.67%	-0.7525	0.12%	0.05%	0.0320	0.05%	-0.37%	-0.3978
3	-0.07%	-0.74%	-0.7852	0.63%	0.68%	0.3804	0.22%	-0.15%	-0.1503
4	0.05%	-0.69%	-0.6948	0.62%	1.30%	0.6895	0.29%	0.14%	0.1362
5	0.12%	-0.57%	-0.5504	-0.26%	1.04%	0.5270	-0.04%	0.10%	0.0933

Tōhoku Earthquake and Tsunami

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	-0.14%	-0.14%	-0.4647	0.25%	0.25%	0.4927	0.02%	0.02%	0.0788
-4	0.03%	-0.12%	-0.2673	0.95%	1.20%	**1.6628***	0.41%	0.43%	1.0880
-3	0.06%	-0.06%	-0.1121	-0.25%	0.95%	1.0723	-0.07%	0.36%	0.7398
-2	-0.16%	-0.21%	-0.3523	-0.07%	0.88%	0.8622	-0.12%	0.24%	0.4291
-1	0.51%	0.29%	0.4294	0.04%	0.92%	0.8043	0.31%	0.55%	0.8793
0	-0.59%	-0.30%	-0.4023	-0.12%	0.80%	0.6407	-0.39%	0.16%	0.2301
1	-1.04%	-1.34%	**-1.6596***	1.13%	1.93%	1.4285	-0.14%	0.02%	0.0310
2	-0.70%	-2.03%	**-2.3623****	0.89%	2.82%	**1.9544***	-0.04%	-0.01%	-0.0155
3	0.15%	-1.88%	**-2.0601****	1.26%	4.08%	**2.6655*****	0.61%	0.60%	0.7130
4	0.14%	-1.74%	**-1.8116***	-1.17%	2.91%	**1.8019***	-0.41%	0.19%	0.2172
5	0.06%	-1.69%	**-1.6697***	-0.46%	2.44%	1.4436	-0.16%	0.03%	0.0360

All 5 Natural Disaster Events

	G7			BRICS			ALL		
Day	AAR	CAAR	t-stat	AAR	CAAR	t-stat	AAR	CAAR	t-stat
-5	-0.20%	-0.20%	-0.6114	0.21%	0.21%	0.1926	-0.03%	-0.03%	-0.1920
-4	-0.05%	-0.25%	-0.4827	0.36%	0.57%	0.6164	0.12%	0.09%	0.2199
-3	0.39%	0.14%	0.1893	-0.01%	0.55%	0.4714	0.22%	0.31%	0.4407
-2	-0.23%	-0.09%	-0.1636	0.31%	0.86%	0.5876	-0.01%	0.30%	0.3323
-1	-0.19%	-0.28%	-0.3796	0.23%	1.08%	0.6894	-0.02%	0.29%	0.3060
0	-0.17%	-0.45%	-0.5501	0.03%	1.11%	0.6529	-0.09%	0.20%	0.1824
1	-0.12%	-0.57%	-0.6739	0.28%	1.39%	0.8395	0.05%	0.25%	0.2235
2	-0.13%	-0.70%	-0.8030	0.32%	1.72%	0.9252	0.06%	0.30%	0.2057
3	-0.18%	-0.88%	-0.9142	0.38%	2.10%	1.1236	0.06%	0.36%	0.3025
4	-0.06%	-0.94%	-0.9185	0.09%	2.19%	1.0810	0.00%	0.36%	0.2711
5	0.23%	-0.71%	-0.6600	0.03%	2.21%	1.0280	0.15%	0.51%	0.3782